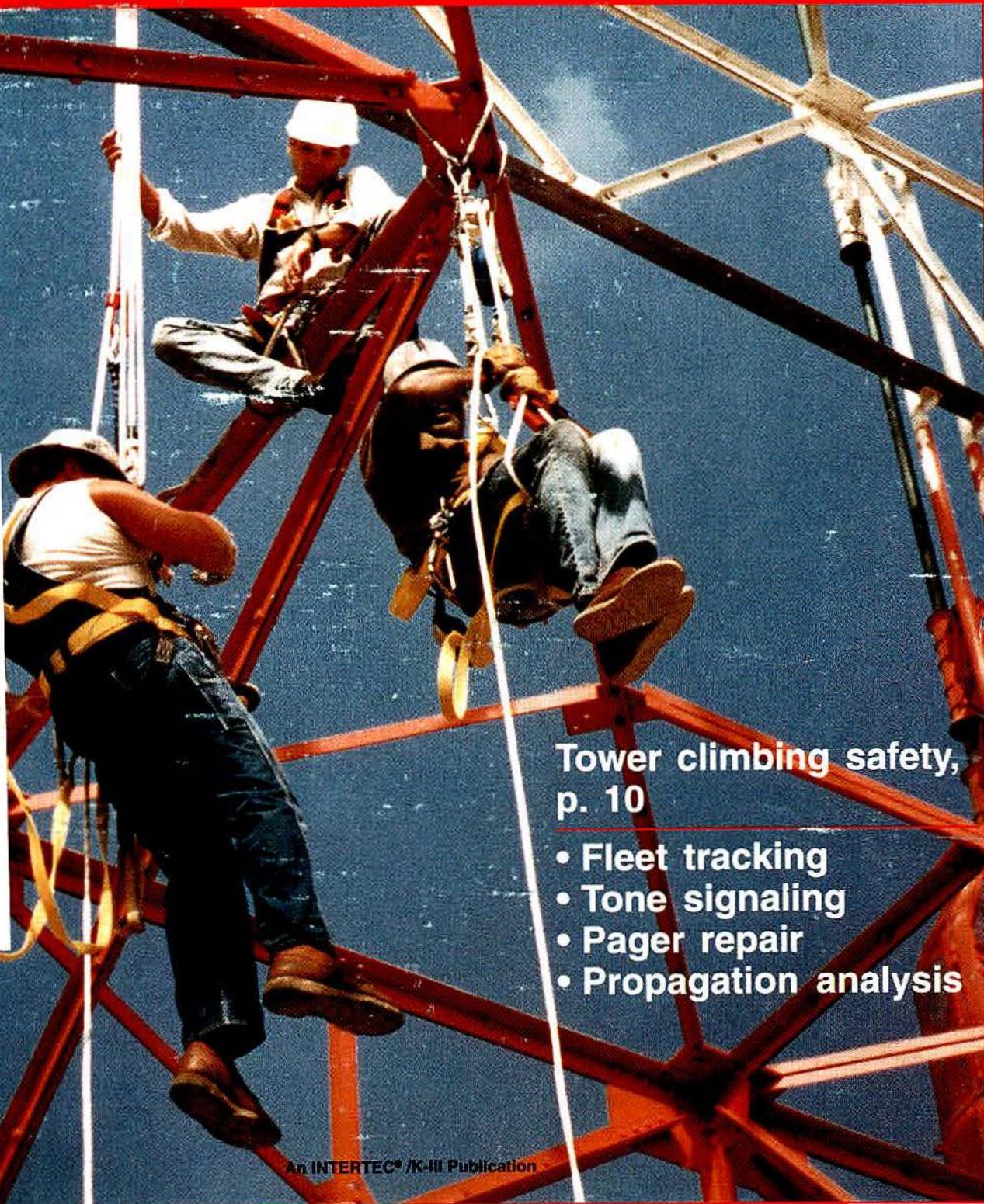


February 1997

Mobile Radio Technology.®

Technical information for paging, SMR and private wireless networks.



**Tower climbing safety,
p. 10**

- Fleet tracking
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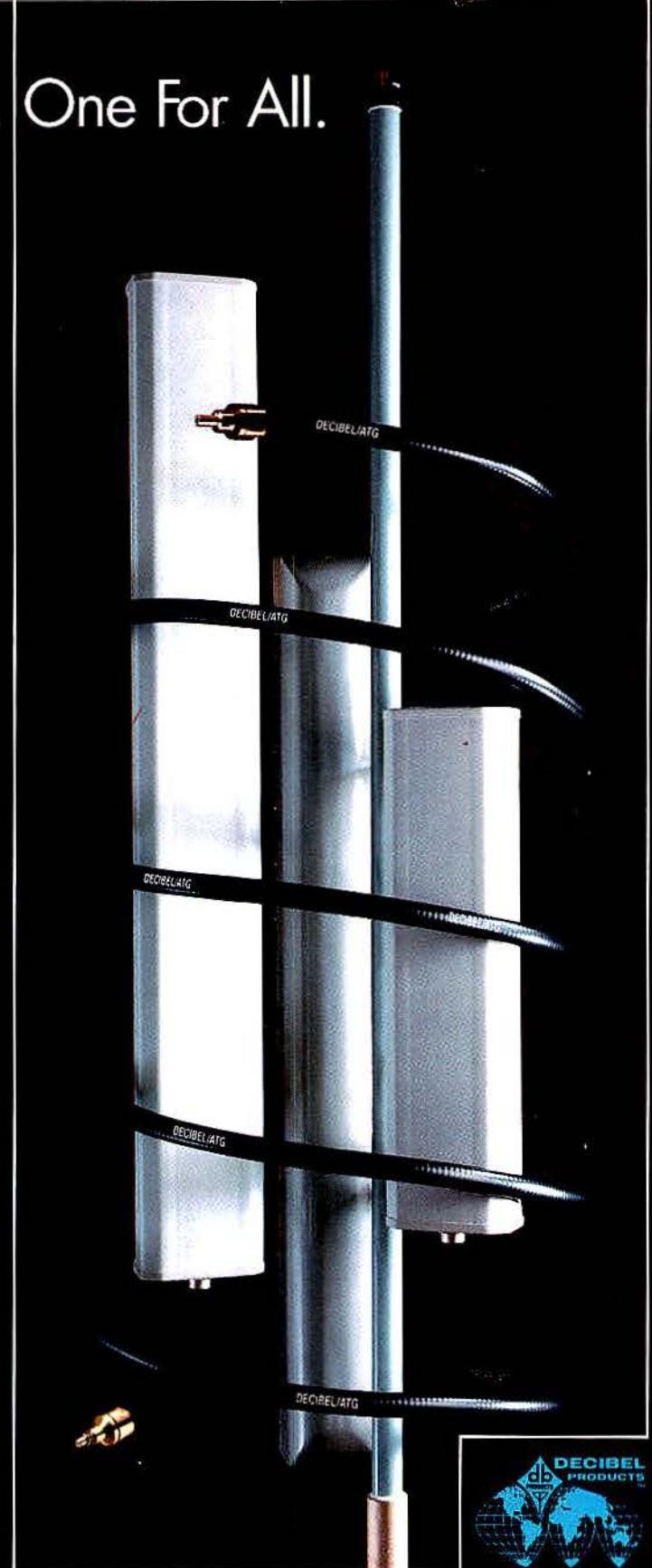
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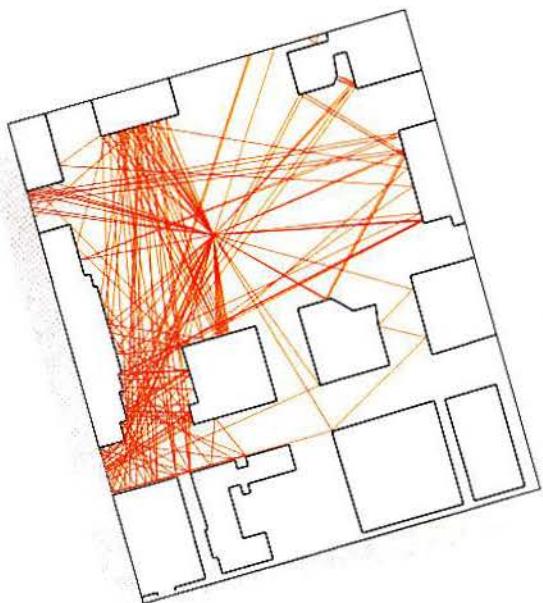
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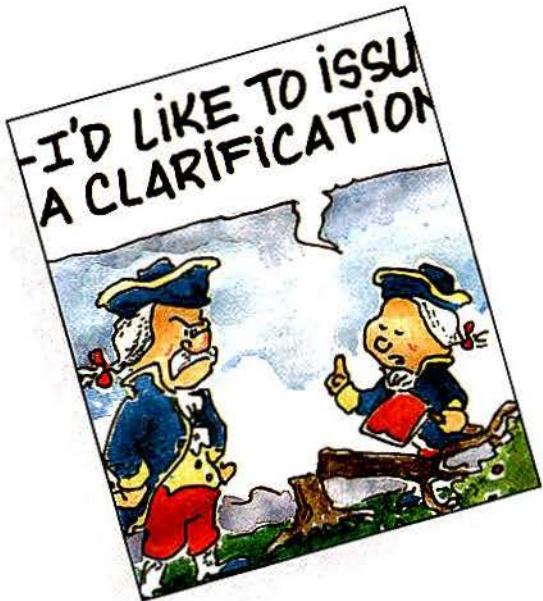
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20 Using AVL technology to expand SMR services*John Kruse*

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28 Tone signaling over telephone lines—**A technician's primer***Donald E. Koehler*

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34 Servicing tips for the Bravo family of pagers*David Ludvigson*

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40 Coverage prediction for digital mobile systems*Harry R. Anderson, Ph.D., P.E.*

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Spectrum refarming: The FCC returns to hook up the appliances



It's like having your kitchen remodeled. When the carpenters, plumbers and electricians are "done," you find that the appliances are installed, but they're not connected to power, water and drains. It's not as though you can't use the sink—that's hooked up—but you can't use the disposal or the dishwasher.

No, maybe it's more like ordering a meal at a restaurant. It's served, and everything's on the plate, but you don't have any silverware, and you can't get the server to come back for a while. It's not a problem at Kentucky Fried Chicken. (You can get your own silverware—or a "spork," actually—or you can eat with your fingers.) But if you've gone upscale, to Red Lobster, for example, not having silverware could be trouble.

It's a lot like spectrum refarming, actually.

See, the original idea, maybe, was to rearrange the technical and operating rules governing private radio on frequencies below 512MHz to make it possible for more people to use radio communications equipment without interfering with each other when they talk. The FCC issued a bunch of new rules intended to remodel these frequency bands, but some of the owners—call them taxpayers or license-holders, manufacturers or trade associations—thought they weren't hooked up right, or they came without sporks. Anyway, using them as they were might have caused problems with medical devices that use radio or might have required expensive followup construction.

Well, you can ask for the appliances to be hooked up or wait for silverware or

whatever, but it's going to hold things up. The plumbers and servers are busy elsewhere by then. Spectrum refarming had been held up by requests for stays, petitions for reconsideration and so forth, leaving manufacturers and license-holders uncertain about what to do, and the FCC was busy with other matters, such as auctioning spectrum. In December 1996, though, the FCC issued a Memorandum Opinion and Order in the refarming matter that may have cleared up some of the uncertainty.

Heavy reading—lengthy, anyway

Look: the Order is a 98-page document. I can't claim to understand all of it. I can't claim to understand all of its implications. I can't claim to have read it. Actually, I found out about the Order when speaking with an attorney at one of the Washington law firms a few days after it had been issued. (No, not the usual firm.) He offered to send me a copy. Then, he apparently decided it was too big, so he sent a copy of the FCC's press release instead. Our friends at Industrial Telecommunications Association (ITA) sent a summary. (Thanks!)

So I'm not going to pretend to have some special insight into the Order, nor is it possible to summarize it on this editorial page. Even ITA's summary is a little more than three single-spaced, typed pages, which is more than this page contains.

What I notice, though, is that the important matter of medical telemetry devices operating on offset channels is covered. They can continue to be operated on a secondary, non-interference basis with an output power not to exceed 20mW (twenty thousandths of a watt).

At the same time, the FCC affirmed its decision to allow coordinators to place high-power stations on the offset frequencies. These might interfere with the telemetry devices, which is why some people asked the FCC to reconsider the matter in the first place, but at least it is decided. I hope the hospitals that use these devices get the word. If I read the regulations correctly, the hospitals must have a related FCC license to use such devices (but not a license for the device itself), so perhaps there is a way to notify them.

Relief for existing systems

On another subject, provision has been made to allow some existing radio communications systems to keep operating without making extensive (and expensive)

modifications. New stations have more restrictive limitations on antenna height and transmitter power, and some people were worried that owners of existing systems would have to spend a lot of money to retrofit. Won't have to, apparently.

Do you remember amplitude-companded single-sideband (ACSSB)? A few ACSSB systems were wedged into the 150MHz–174MHz band years ago, before the 220MHz–222MHz band was reallocated from radio amateurs for the purpose. A few people have ACSSB systems that work well for them, and they installed them because no alternative FM system would fit their coverage requirements. Those who have 'em can keep 'em, until Aug. 1, 2003. That's good.

A manufacturer of ACSSB equipment, by the way, asked the FCC to change its refarming rules to specify 5kHz-wide channels, because that's what ACSSB signals fit *today*, without having to wait for a migration from 12.5kHz-wide and then to 6.25kHz-wide channels. "No," was the answer. I remember my early studies of frequency modulation (FM), and how the audio fidelity and resistance to noise and static diminish as the frequency deviation is reduced. Maybe digital signal-processing will overcome reception problems with the tiny deviation required to fit FM into 6.25kHz-wide channels. Otherwise, SSB proponents have a point. Amplitude modulation (AM) and its derivations, including SSB and linear modulation, already work in narrow bandwidths.

When the FCC returns, again

So, those are a few things that the FCC decided in its Order. What did it leave for future decisions? From the ITA summary:

- Expansion of the authority delegated to frequency coordinators.
- Migration of low-power systems to newly designated low-power channels and the appropriate time for the migration.
- Designation of certain VHF highband channels in the Forestry-Conservation Radio Service for wide-area use.
- The degree to which existing licensees may claim "technology" channels created through narrowbanding.
- Modification to the station identification requirements to permit transmission of the station identifier in digital format.

After all, when is remodeling ever really done?

—Don Bishop

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 The R-2680 with optional MPT 1327 (AH)
 The Micro RF Isolator (AF)
 All of the above (AZ)

2. What do you usually test?

Two-way radios (JA) Pagers (JE)
 Trunked radios (JF) Cell sites (JT)
 Encrypted systems (JG) Cell phones (JU)

3. When do you plan to buy test equipment?

In 1 month (HA) 7-12 months (HC)
 2-6 months (HB) More than a year (HD)

4. Do you buy test equipment in your company or does someone else?

I do (EA) Someone else _____ (EB)

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23-26—**Energy Telecommunications and Electrical Association**, New Orleans Convention Center, New Orleans. Contact: 214-235-0655.

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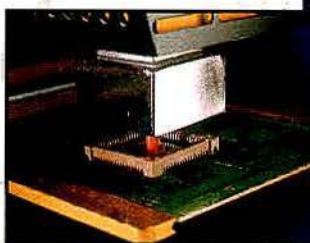
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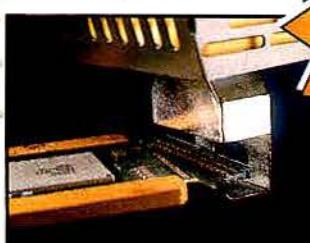
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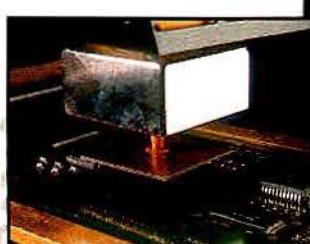
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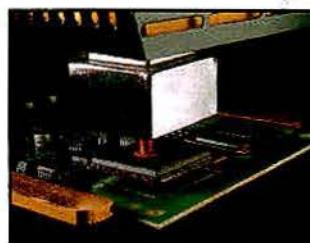
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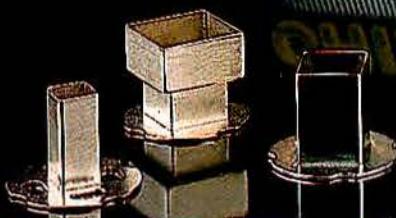
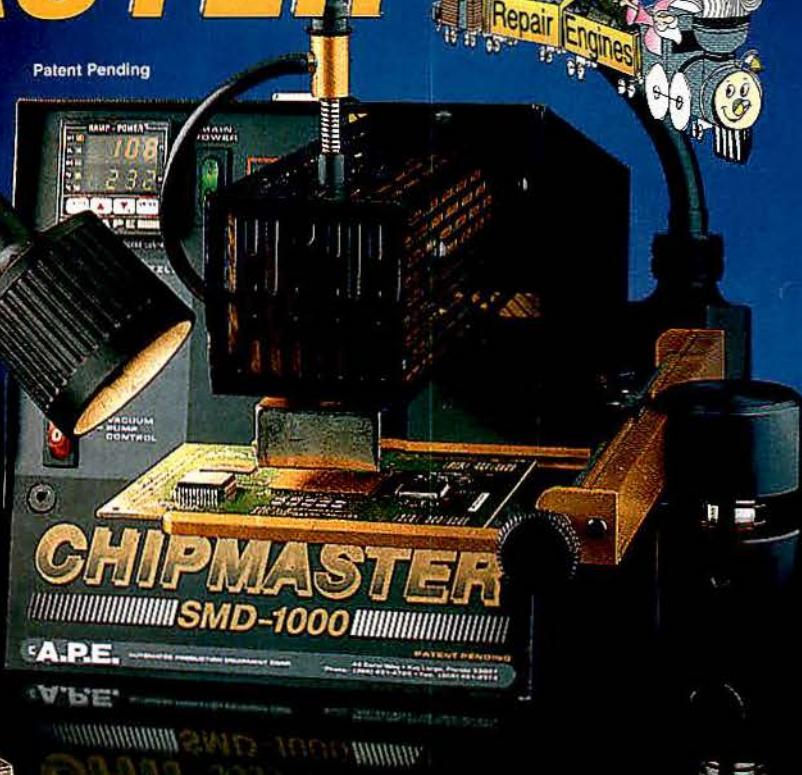


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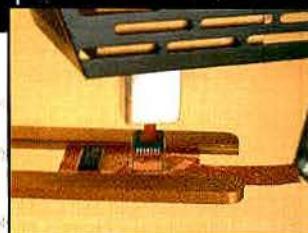
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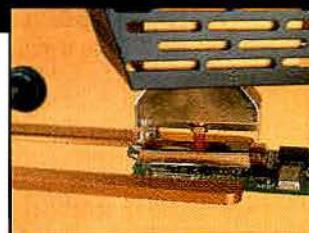
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Simple test antennas

By Harold Kinley, C.E.T.

There often arises a need for a simple antenna to be used for various test purposes. This column will describe some simple antennas that can be easily constructed using readily available materials.

Half-wave dipole

The half-wave dipole is an excellent 0dB gain reference antenna. The simple dipole shown in Figure 1 below can be constructed by using $\frac{1}{2}$ -inch copper pipe fastened to a small board. Two copper pipes are used, each cut to $\lambda/4$ at the operating frequency.

In Figure 1 note that a *balun* is used to convert the balanced antenna to an unbalanced transmission line (coax). Balun is an acronym for *balanced to unbalanced*. The balun shown in Figure 1 is made of a Pawsey stub. The Pawsey stub is made of a quarterwave section of transmission line identical to that used to connect to the antenna feedpoint. The Pawsey stub permits the use of a coax (unbalanced) line with a balanced antenna while maintaining a 1:1 impedance ratio. Thus, we get 75Ω balanced to 50Ω unbalanced.

Coaxial dipole

The coaxial dipole shown in Figure 2 bottom right is made by folding a $\lambda/4$ section of braid back over the outer jacket of the coax cable. This antenna is more easily constructed at UHF and higher frequencies because the length of braid that must be folded back over the cable is shorter than at the lower frequencies.

Impedance matching

If the equipment to which you are connecting the antenna has a 75Ω input impedance you can connect the antenna directly to the instrument (receiver or spectrum analyzer, for example). If the instrument has a 50Ω input impedance (which is the case for most of our work), then the 75Ω antenna impedance must be matched to the 50Ω instrument impedance. There are several ways by which the 75Ω an-

tenna can be matched to the 50Ω impedance of the test equipment or receiver.

Resistive pad

A simple "L" network resistive matching pad can be used to make the transition from 75Ω to 50Ω . The resistive network is shown in Figure 3 on page 53. This is a minimum-loss "L" pad. The loss of the matching pad is 5.7dB. It is easy to build these pads for use at lower frequencies, but at the VHF highband and higher, it is difficult to build a high-quality pad. At these higher frequencies it is best to buy a commercially manufactured pad. Reasonably priced pads are available that will operate well into the gigahertz range.

Transmission line stubs

One of the easiest ways of matching impedance is through the use of a tuning stub located at a point on the transmission line. Shorted or open stubs may be used. The trick is to determine the length of the stub and where on the transmission line it should be placed. This is where the Smith Chart (1) shines! Using a computerized version of the Smith chart (ARRL MicroSmith) the exact location and length of the tuning stub is easily determined.

The results are posted in the sidebar on page 53. Results are shown for both an

open and a shorted stub for use at 155MHz. The distance (D) is the distance from the load (antenna feedpoint) in inches. The length (L) is the length of the stub in inches. The formulas in the sidebar on page 54 allow you to calculate the length

(continued on page 53)

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is a member of the Radio Club of America and the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewylde Drive, Spartanburg, SC 29301. E-mail: (hkinley@aol.com). Smith is a registered trademark of Analog Instruments, Box 808, Providence, NY 07974.

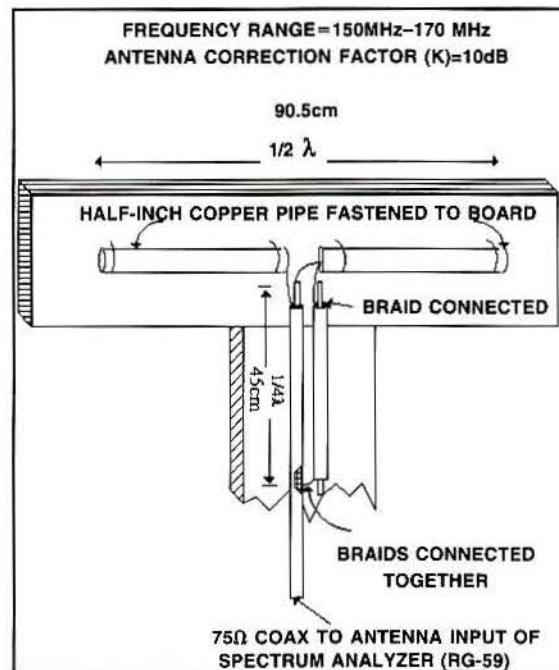


Figure 1. This homemade dipole antenna can be constructed using $\frac{1}{2}$ -inch copper pipe. This provides for a wide bandwidth. The Pawsey stub provides for a *balanced to unbalanced* (hence, *balun*) connection while maintaining a 1:1 impedance ratio.

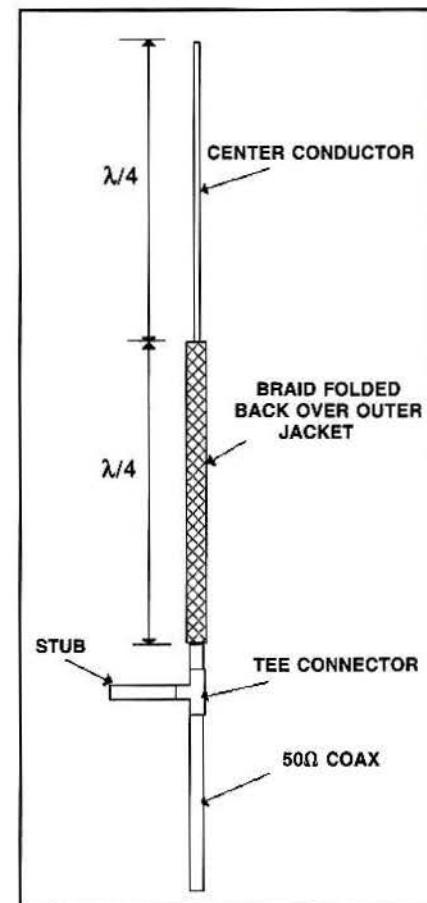


Figure 2. The coaxial dipole shown here requires no balun. It has a 75Ω feedpoint impedance. It is constructed by folding the braided shield back over the outer jacket of the coax cable. The relatively short dimensions at UHF and higher frequencies make the construction easier than it would be at VHF and lower frequencies. The antenna has a K or antenna factor of 19.5dB at 460MHz and 24.8dB at 850MHz.

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Tower climbing safety and rescue

Safety is an obligation of all parties associated with the installation and maintenance of communications towers. The government has explained what will be done and how. Communications professionals must now use the proper equipment, techniques and training to meet compliance.

by Winton Wilcox Jr.

The individuals who build and maintain wireless communications systems operate in one of the most hostile environments of any workplace. These professionals hang like spiders, often hundreds of feet in the air, while skillfully mounting, adjusting and repairing transmitting and receiving equipment. Our systems require the skills of these special technicians, and their lives depend on our help. Whether you are a climber, an employer or a climber subcontractor, you are responsible for safety.

Imagine climbing a 20-story-high ladder (200 feet), then "scootching" (straddling the pipe or beam and sliding) several feet from the ladder to the mounting location for the antenna. This crossing is most often done on a tower member that is only a few inches in diameter. Following the "tight rope" act to reach the face of the structure, you now crawl out farther (the stand-off distance) and then hang in midair and fasten an antenna or panel to a small bracket or pipe. One slip, one error, and the climber falls 200 feet to the ground.

Valiant tower workers develop an in-

sider, "macho" attitude. Managers, owners and non-climbers respond by adopting a hands-off approach to these hazards, and the government steps in to protect the workers. Today, there is a lot that can be done to guard climbers from fall hazards. To guarantee that climbers are safer, the Occupational Safety and Health Administration (OSHA) has clearly explained

cant task. You cannot simply buy the solution. Effective implementation of fall protection may take you several months. "You can't implement the solutions sitting in your New Jersey office," said Barry Ferguson, a safety consultant for AT&T and a member of the National Association of Tower Erectors' (NATE) OSHA relations committee. When charged with AT&T's compliance to the regulations, Ferguson spent hundreds of hours visiting towers, consulting with tower workers and evaluating potential equipment. Although Ferguson has many years' experience working with OSHA and safety programs on a large scale, he said he was amazed at the complexity of this problem. Initially addressing ladder safety issues, progressing to personal fall arrest systems and then resolving the rescue requirements became a major project.

The Tower Climbing Safety Program at AT&T includes equipment supplied by four vendors. Training is an intensive two-day program for climbers that includes both classroom and field practice activities. Certified climbers must pass a written examination and physically demonstrate proper use of all equipment and techniques.

While this climbing safety program is excellent for structures and work performed by the AT&T workers, it is not a universal solution to tower climbing safety. You must develop your own policies and programs for climbing safety.

Development of your fall-safety program requires thoroughly understanding the fall hazards that you, your climbers or



what will be done and how. Communications professionals must now acquire the appropriate equipment, develop the techniques and implement the training to comply with the law.

Different situations, different solutions

Providing appropriate and legal solutions to your climbers' safety is a signifi-

Wilcox is president of Comtrain, communications training and consultants, Monroe, WI.

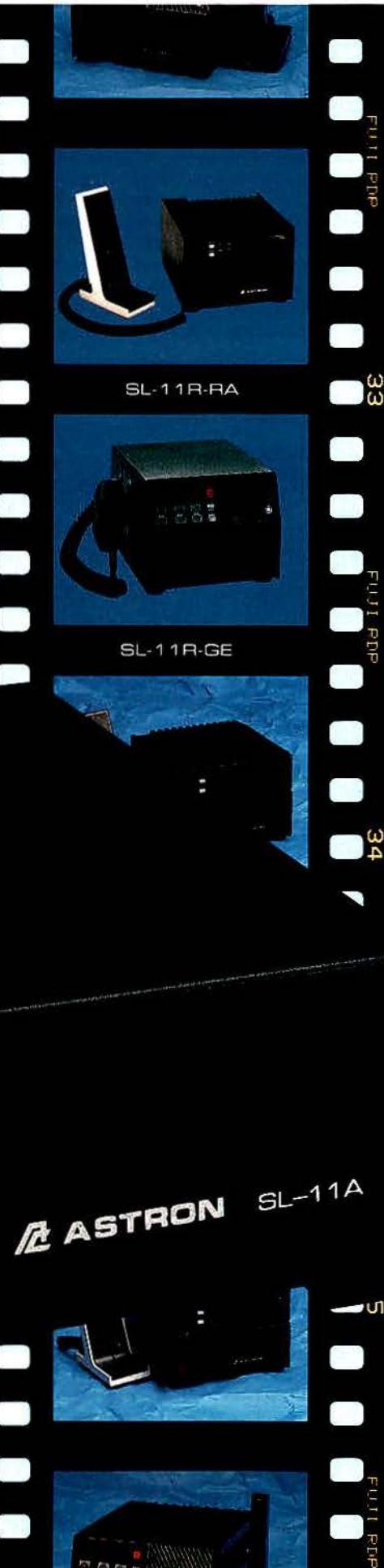
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your subcontractors will face. Hazards depend on the types of structures, the climbing devices used, the tasks being performed and the equipment being used. The task of mounting a transmission line to the inside leg of a water tower requires different equipment than the task of mounting a cellular antenna panel on a monopole. Crossing the large, open face of a self-supporting tower presents different fall protection problems than crossing

a small, guyed-tower face. Climbing pegs or step bolts suggest different problems than climbing a fixed ladder. Once you have a clear understanding of the fall hazards in your particular environment, you are ready to look for solutions. These solutions begin with equipment.

Fall protection equipment

For nearly eight years, OSHA, employers and manufacturers have argued, exam-

ined and developed answers to the need for fall protection. There are hundreds of products to address the problems. Unfortunately, these products are predominantly directed at larger markets rather than at the highly specialized world of communications tower workers. There are more customers in the roofing industry, in the general contractor construction industry and even in the window-washing industry than in tower climbing. It is natural for manufacturers to concentrate on products that can be sold to a larger market. The lack of standards in tower construction, tower erection, tower maintenance and tower use accents the problem of developing universal solutions to tower-climbing safety. Because there is no standard "tower," there is no universal equipment to address the fall hazards that climbers face. Recognizing this diversity requires that you consider your climbers' work and acquire component equipment. When working, it is the responsibility of the climber to use the components to address the specific task and environment confronted. You must provide the climber with the component equipment and training sufficient to adapt the components to the environment.

Components of your fall safety equipment and procedures may include temporary or permanent horizontal and vertical life lines, rope and cable grabs, ladder climbing devices, full-body harnesses (body belts will not be legal much longer), self-retracting lanyards, positioning lanyards, shock-absorbing lanyards, special connecting hardware, suspension equipment and multiple rescue equipment.

If any of these components is unfamiliar, there are several sources of information. OSHA has carefully and clearly defined the components in the standards. You can find definitions and clarifications in OSHA standards 1910.66, 1915 SubPart I App A, 1926.500 and others. You will find that manufacturers have a wealth of information on the subject. Consult suppliers of safety equipment. Check with NATE. NATE continues to work with OSHA to refine training and certification issues in fall safety and is an excellent source of information and references on the subject. Special consultants, such as our company, and trade associations will readily provide you with contact information for manufacturers, state and federal OSHA services and other companies who have similar problems.

Fall restraint and fall arrest

Keep in mind that fall protection encompasses two major elements. These are *fall restraint* and *fall arrest*. Fall restraint is a method of preventing the climber from

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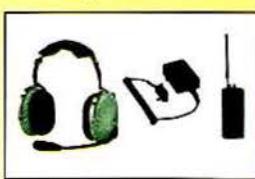
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Circle (6) on Fast Fact Card

getting into a fall hazard. This is nearly impossible in the world of tower climbers. The only methods of preventing a fall hazard on a communications tower (ignoring the obvious solution of not climbing in the first place) are platforms and (with a little stretch of the definition) the use of positioning lanyards. Few towers have adequate platforms in the work area.

Fall arrest addresses the need to stop a fall, once one occurs, with minimal damage

to the climber who has fallen. If we reject the use of nets (and eliminate fanciful solutions such as wings, parachutes and jet packs), we are left with the conclusion that fall safety (restraint or arrest) requires the worker to be 100% connected to the structure.

Selecting the individual component equipment is also dependent on accepting workable techniques for using the equipment to resolve your specific fall hazards.

For example, if you select a single, six-foot-long, shock-absorbing lanyard, you are assuming that the climber has adequate connection to the structure without the need to reconnect. If the climber must move beyond the reach of the connection, the climber will be forced to disconnect the lanyard and reconnect it at another location. During this interval, there is no connection! This means that during the reconnection process there is no fall arrest. There are techniques to overcome this. A climber might have sufficient structure to connect the shock-absorbing lanyard, cross a few feet, then attach with a positioning lanyard. Once restrained by the positioning lanyard, the climber could then disconnect the shock-absorbing lanyard and reconnect to an anchorage point nearer the destination. In this scenario, the climber remains 100% connected. Manufacturers generally depict use of these single fall-arrest lanyards as attaching to a horizontal life line or trolley. The decision to equip climbers with a single shock-absorbing lanyard may direct you to include horizontal life lines as a component of your fall safety equipment.

Training

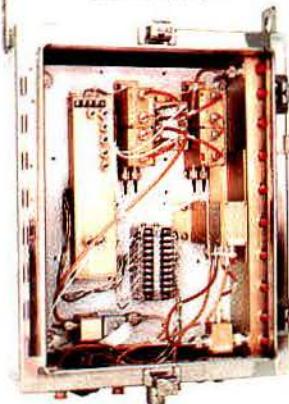
After identifying the specific fall hazards facing your climbers and selecting the appropriate safety equipment, develop a method of training your climbers. This training will create more questions and problems than you may initially suspect. Because the application of components and techniques will differ in individual applications, you cannot simply teach from a checklist. Climbers must clearly understand the objectives and their responsibilities to apply the tools and techniques to meet these objectives so that they are equipped to handle any situation that may arise. You cannot teach "always do this" or "in this case always do that." Your climbers should understand your policies, the regulations and their individual responsibility. They must also understand the use, care, inspection and maintenance of all safety equipment they will be provided. Climbers should understand the function of each component and its relationship to other components if they are to configure the fall protection equipment to their individual work and environment. Plan and implement the training thoroughly. Set objectives, techniques and measurement of success before beginning the training.

As with equipment selection, there are a number of sources for help with training. Teaching experience is critical to the presentation of training information. Your

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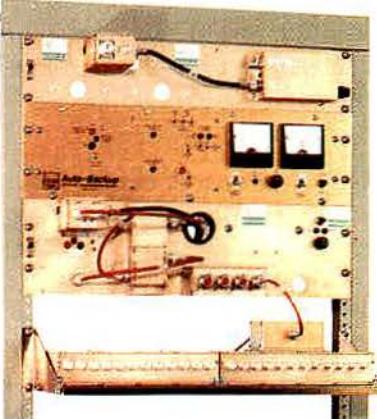
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local junior colleges, high schools and technical centers can provide a lot of help in establishing effective programs. Also, contact your suppliers. Many manufacturers offer training in climbing safety and rescue, or they can recommend specialists who can provide the training. Assuming you cannot locate training appropriate to your particular equipment configuration or policy, you can adapt the instructions that manufacturers must provide

with each piece of equipment you purchase. Check with your local or state OSHA offices. Often, there are OSHA services available to help develop safety plans, training programs and documentation. Work with a recognized company that provides consulting, development and training solutions specific to your problem.

Verification

What constitutes proper training? What

is a "competent person" in terms of climbing safety? Can you certify the training? Who can certify the training, and how? Unfortunately, there are more arguments and opinions on these questions than there are answers. OSHA is continuing to clarify and define the terms. There are some precautions you can implement to ensure the high quality of your plan and your programs now. Include your fall protection programs in your overall company safety plans. Write them down. You can get a sample safety plan from OSHA if you need a blueprint.

If you work with consultants or accept outside training, be sure the supplier has all the needed insurances and warranties. It is normal to ensure that a provider has workers' compensation insurance, auto insurance and general liability; but remember, if your consultant or provider is delivering training or providing documentation, they should have "errors and omissions" insurance to protect you. One good test of competence and certification is whether the expertise has been accepted as competent by other clients. Always check references.

Your training will be met with resistance by experienced tower climbers. The "ol' timers" will tell you hundreds of reasons why your equipment or techniques will not work. You must be prepared for this conflict. The best preparation is to be thorough in your understanding of what your climbers do, and how they do it, before selecting equipment and developing techniques for fall protection. Recognize that your technicians can surely give you an example of a situation where the equipment or the techniques are more dangerous than "free climbing." Even OSHA has recognized this reality. Ultimately, it is the climber we are working to protect, and it is the climber who must apply the tools and techniques.

Rescue

If you are successful in implementing fall protection, you will inherently create a new safety concern for the climber. The whole concept of fall arrest dictates the necessity of rescuing the worker who has fallen. Without fall arrest, there is rarely a need to "rescue" a fallen worker—just to "replace" him. With fall arrest equipment properly used, a fallen climber can become a helpless victim. Instead of falling 200 feet, as in the opening example, our climber will fall a maximum of 9½ feet and remain suspended nearly 190 feet in the air. This raises a number of questions. How long can the climber remain suspended before the climber begins to suffer? How can you reach the climber

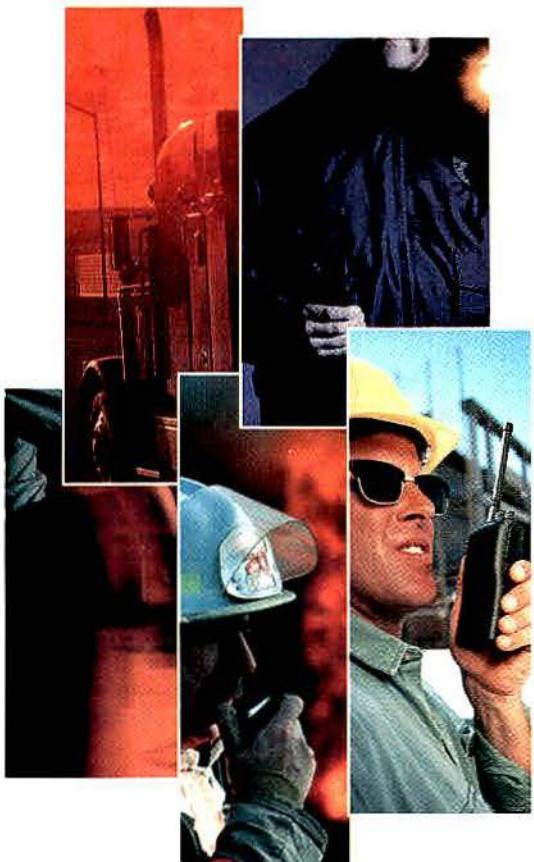
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and get him safely to the ground? Who can rescue the climber? You must address these questions and implement solutions to the problem.

Resolving the requirements to provide a rescue plan requires several considerations. Before you can implement any rescue, you must be aware that a fall has taken place. Timeliness is critical. The tradition of dispatching a technician alone to replace a tower light on his route home

is simply not acceptable. A single climber may fall and remain suspended for hours before anyone even knows the fall has occurred. (This is particularly true for a communications tower, which may be situated in a remote site.) If the fall was precipitated by electric shock or a medical condition, the climber may be unconscious and unable to call for aid. Recognizing this concern, many companies have adopted a program of ensuring that

a second person is always on-site during a climb. This second person can call 911 in an emergency. Does this resolve the rescue problem? Probably not! Consider our climber at 190 feet. Assume the 200-foot tower is 18 miles out of town, on a hill top and accessed by an unmarked dirt road. Even if the 911 center dispatches an emergency response team qualified to work at these heights and in this environment, how long will it take them to assemble the qualified individuals and respond? Perhaps the fire department has a hook-and-ladder vehicle to effect elevated rescue, but how many communities have the need for rescue ladders that can reach the equivalent of the 20th floor of a building?

Consider in your plans that the most competent rescue source for a climber is another qualified climber, equipped with the correct apparatus, training and preparation.

When designing your rescue plans and procedures, you must be sure that you understand the location and nature of the structures being climbed. In your plans, you must also confirm the availability of response teams and their response times to your structures. Because tower sites often do not have street addresses, you may want to provide a description of the location that the 911 center can enter into its dispatch database.

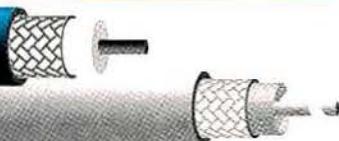
There are a lot of pieces of rescue equipment available today. There are self-retracting lanyards with hand cranks to "reel in" the fallen climber. There are systems to rescue skiers from gondolas and chairlifts that can be adapted, and there are manlift systems, both manual and assisted. Remember that some solutions require technicians to implement, and the nature of tower work often limits the size of a crew to two or three total members.

Conclusion

The effort to select the correct equipment and to develop rescue technique is much more difficult than the fall-protection project. Because of the wide array of answers to this problem, OSHA is flexible. The objective of a timely and safe retrieval is to get the climber to safety. Investigate equipment suppliers and challenge their answers in terms of your specific needs. You may need to incorporate several rescue tools and techniques in your program to ensure that you, your employees and your contractors are protected from this hostile environment. Talk to other climbers, associations and companies sharing the problem. Experiment, test and confirm that your climbers can and will be rescued and returned to safety.

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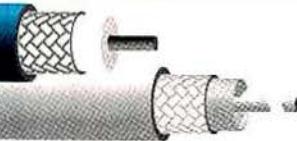
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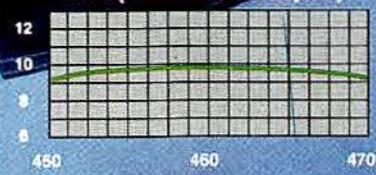


Vertical
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VSWR Typical VSWR



dBd Gain (Relative to 1/2 Dipole)



Circle (12) on Fast Fact Card

Using AVL technology to expand SMR services

What can SMRs do to increase revenues when channel access is diminishing and competition is becoming more intense? Providing AVL products and services for business fleet management may be the answer.

By John Kruse

Global positioning systems (GPS) and mobile data communication technologies are contributing dramatically to the potential of specialized mobile radio service providers (SMRs) to augment product sales and services to their existing customers and to attract numerous new customers. Although educating the business community to the benefits of automatic vehicle location (AVL) is a process that was slow to start, awareness and interest in the technology is accelerating. The established SMR is in an ideal strategic position to capitalize on providing business fleet customers with technology that can increase revenues and reduce costs in virtually every vehicle fleet operation.

Global positioning is the process of determining a precise location on the earth's surface. This is made possible by the existence of satellites launched by the U.S. Department of Defense. The transmissions from these satellites are available to the private sector at no cost. A GPS receiver on the ground receives and compares signals from several of these satellites simultaneously and performs calculations to determine the longitudinal and latitudinal coordinates of the position of the GPS receiver.

Much has been written and reported on applications using GPS. The term "precision farming" is used to describe the many uses of GPS in agricultural operations. Rental car agencies are providing in-car systems that will help drivers navigate through unfamiliar territory. Auto manu-

facturers, including Ford (Lincoln) and BMW, are offering options that automatically place 911 calls for help and communicate the location of vehicles at the touch of a button. GPS positioning has been demonstrated to have tremendous utility and can be adapted to a wide variety of marketable uses.

There is a natural niche for SMRs to market AVL products and services for business fleet management. A large percentage of SMR customers today are small- to medium-sized operations including messenger services, courier services and vehicle towing and repair services. These customers are already buying air time for voice communication. Offering AVL products and services adds a new dimension of revenue opportunity for SMRs.

Applications

What marketable benefits does AVL bring to fleet management? For any given industry and operation there would be many. The following generic features would apply to most applications.

► **Monitoring vehicle activity** — The movement of many vehicles can be tracked simultaneously. The computer screen shows symbols for vehicles traveling over a map, as shown in Figure 1 at the left. Dispatchers can more efficiently direct activity of vehicles when locations are known. Assignments can be given to vehicles based on their proximity to the job to be done. Managers at the base can stay apprised of progress of vehicles on the road. By knowing where vehicles are located, there is an inherent advantage to being able to coordinate the efforts of the entire fleet, maximizing the use of personnel and fleet assets.

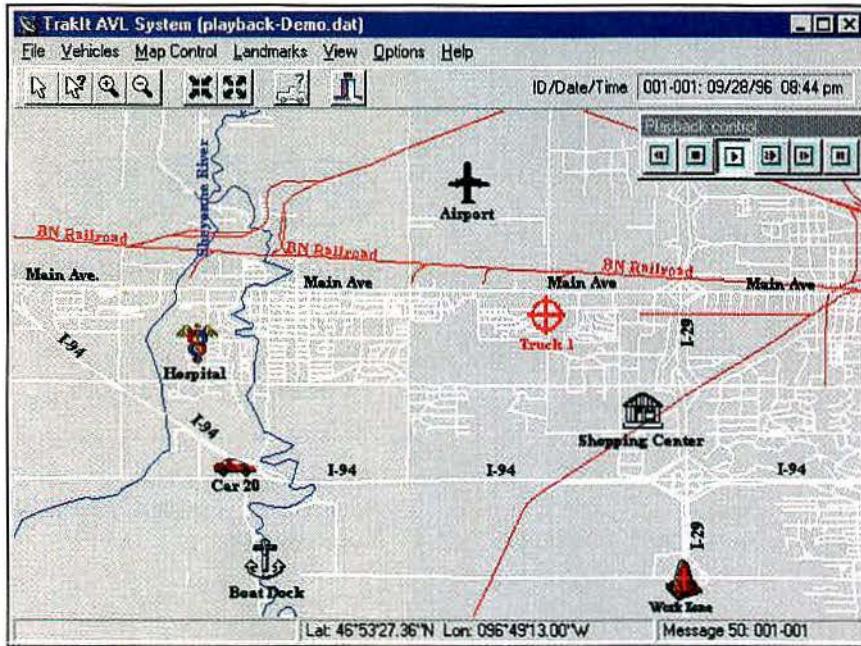
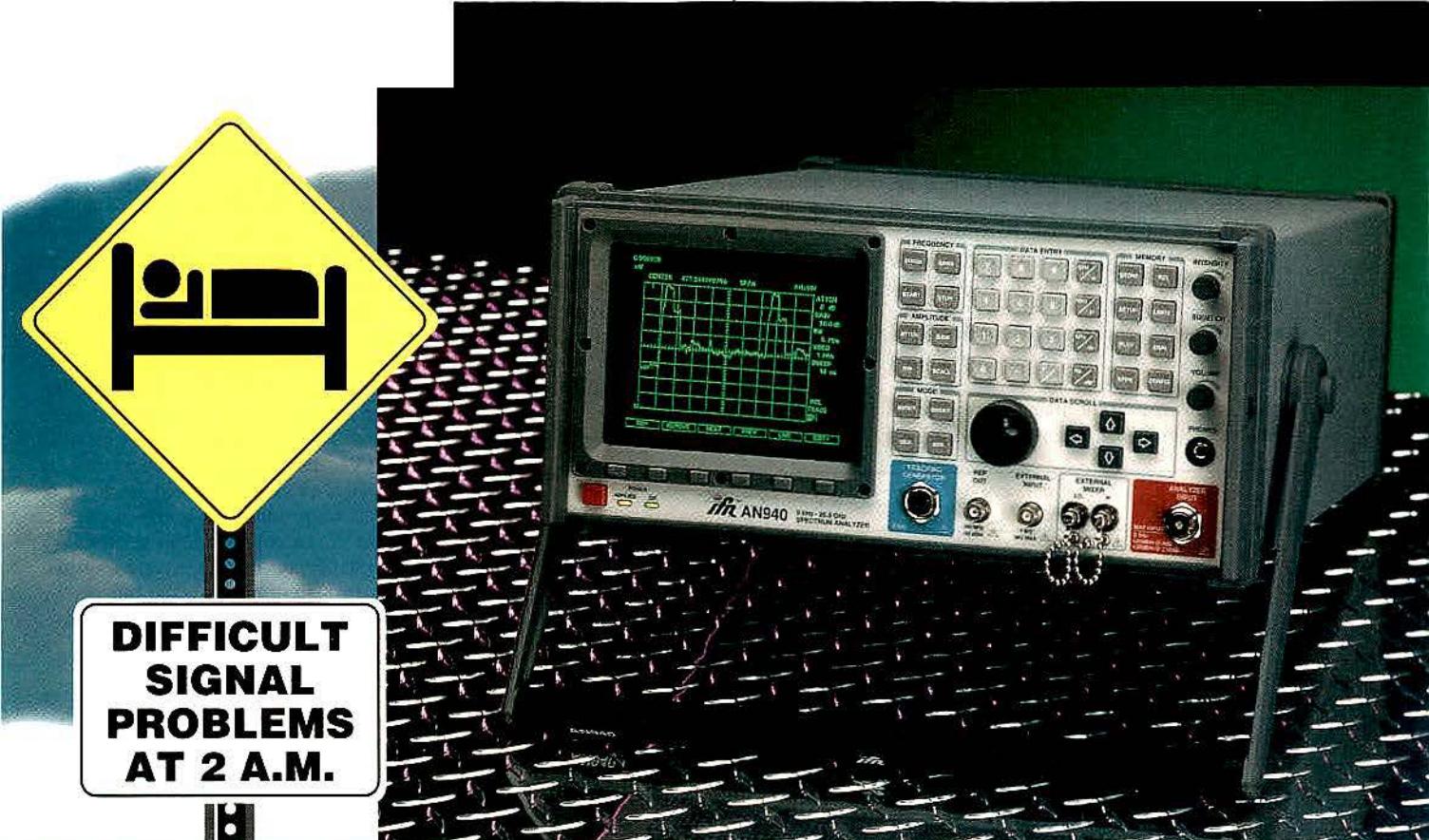


Figure 1. The TRAKIT GPS AVL monitoring system superimposes symbols for vehicles on a map background. Vehicle location can be monitored in real time or played back for reference.

Kruse is chief executive officer of IDA, Fargo, ND.



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► **Activity review** — The activity of the vehicles can be played back for any time period. This function can be useful for efficiency analysis or for reviewing where vehicles have been, and at what time. Questions of what took place can be answered. A sequence of events can be reconstructed. Being able to view a month's activity in the time frame of a few minutes is an important management tool. Analysis can lead to changing operations

to increase efficiency. Accurate and detailed history of fleet activity can be proof to help reduce exposure to liability. It also can be used to quickly dispel a complaint or to demonstrate promptness and reliability regarding vehicle locations. The feature of reviewing past activity of vehicles can contribute to increasing operation efficiency and can also be used as a marketing tool.

► **Data capture** — Times and locations

are captured in computer data files. These files can be converted into a wide variety of useable formats for management analysis, vehicle preventive maintenance and credible documentation of fleet activity. Files can even be exported to bookkeeping applications for billing and costing. The proliferation of computers and software in business today has resulted in the popular use of spread sheet and database systems. The availability of exportable GPS AVL data opens new opportunities for businesses themselves to manipulate the data to produce in-house analysis. Creative uses can be made of the data for more appropriate customer reporting and billing. Instead of billing a flat rate or "by the run," billing could be based on time, distance or zone.

► **Driver performance accountability** —

AVL systems intrinsically create an awareness in fleet vehicle drivers that their actions can be closely monitored. This feature allows the measurement of performance and the discouragement of abuse of the independence of drivers while away from the base. It has been estimated that closer control of drivers' activities can return a 30% increase in efficiency and use of operation assets. It's an old management axiom that if you monitor something, it improves. It is natural that with dispatchers or supervisors at the base watching activity of the drivers, and with the drivers aware that they are being watched, ethical work consciousness and adherence to the task at hand will be promoted.

► **Emergency alarm** — An important function of a comprehensive AVL system

is the ability to alert the control base of an emergency condition along with the exact vehicle location. This can be accomplished by the driver pushing an emergency button or by the system detecting an event such as rapid deceleration, airbag deployment, collision or other occurrence. The cellular industry has had considerable success in marketing cellular communication's usefulness in emergency situations. In contrast to cellular, AVL vehicle equipment installation is totally inconspicuous, the placing of the emergency call is transparent (or "silent") and the exact location is immediately known at the dispatch base. The driver in an emergency situation may not be able to convey an exact location. Being able to provide GPS AVL coordinates to emergency response teams allows dispatch of aid quickly and directly to the scene, eliminating any confusion as to the location. The justification of investing in GPS AVL technology becomes obvious when quick and accurate response to an

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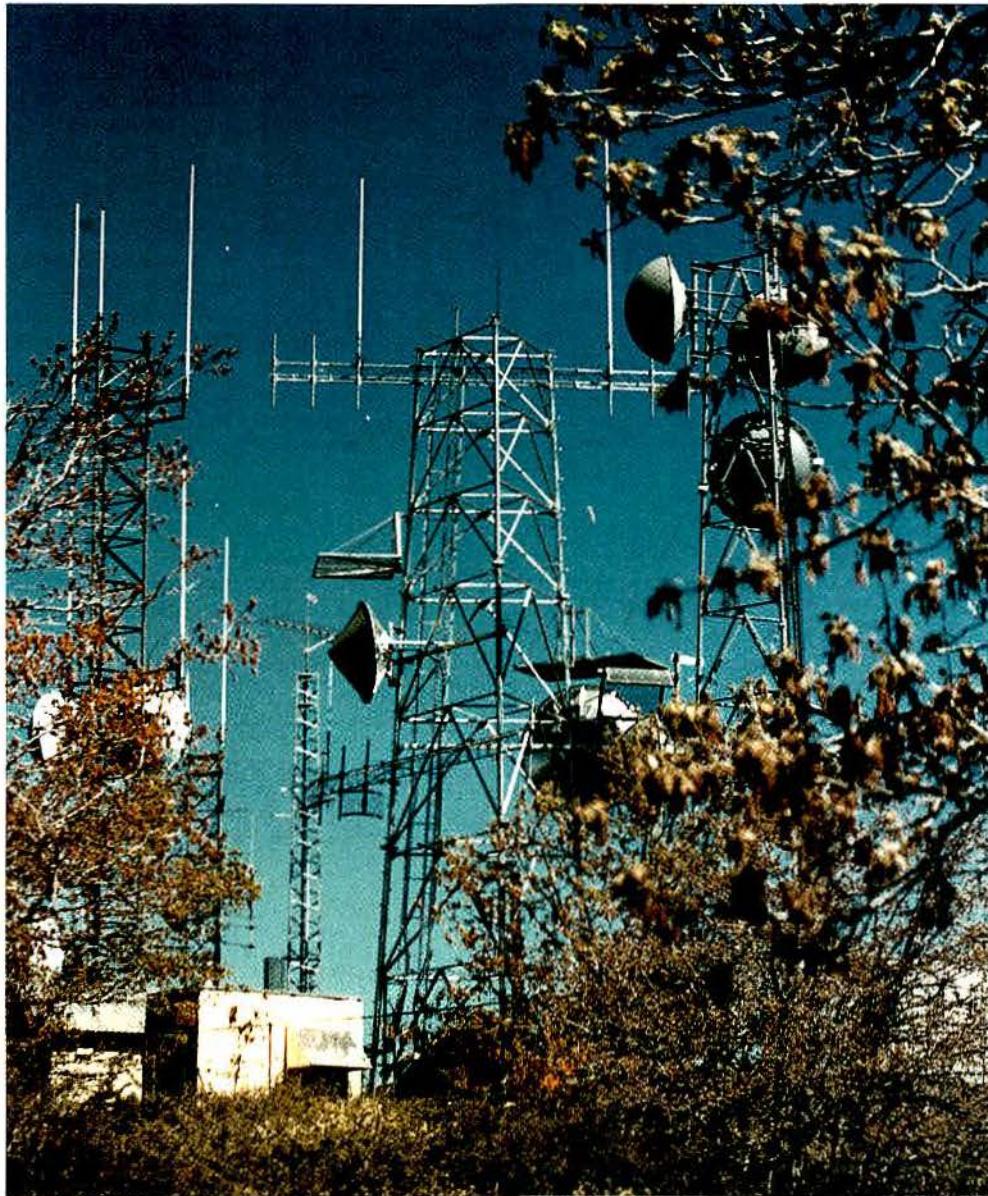


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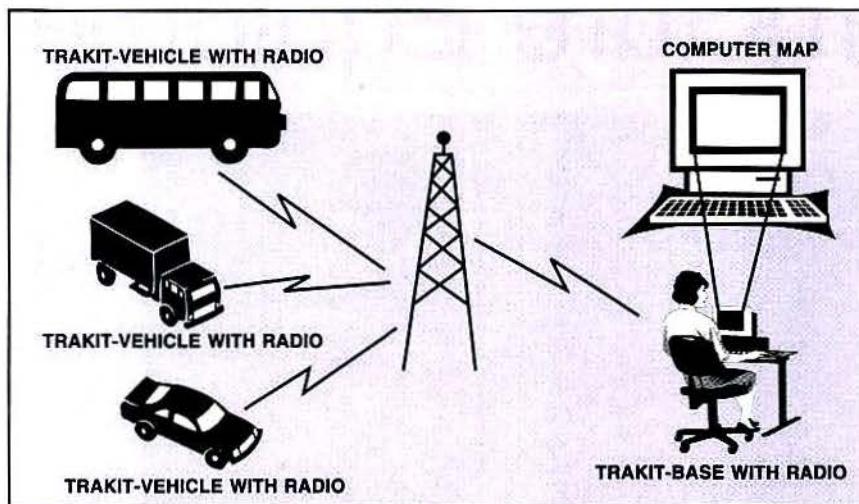


Figure 2. An AVL fleet management system includes radio transceivers, intelligent GPS units and appropriate antennas mounted in fleet vehicles, which are monitored by software at the base station.

emergency has the potential to save people's lives.

The AVL system

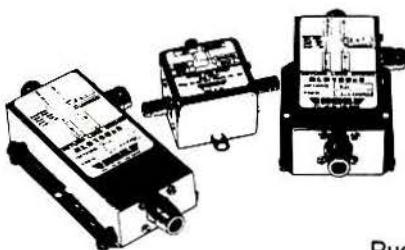
As shown in Figure 2 above, the required components of an AVL fleet management system in the vehicle include a

radio transceiver, an intelligent unit with GPS capability and appropriate GPS and RF antennas. Equipment required at the base includes a computer to run the AVL software, a radio with antenna and the AVL base unit. Specialized applications may require additional equipment.

Installation of the small radio/GPS AVL bundled unit in a vehicle is uncomplicated and unobtrusive. It can be located in any out-of-the-way place in the vehicle, including under a seat or in the trunk. A power connection and provision for the radio and GPS antennas is required. It is adaptable to being portable with easy transfer from vehicle to vehicle.

The RF channel used to communicate GPS AVL position data back to the base can be trunked or conventional, 800MHz, 450MHz or 220MHz. Setting up an RF customer with AVL can be creatively and craftily managed to provide the customer with the desired service level of system performance while charging appropriately for the air time. Customers who require only a small amount of air time for AVL can be easily added to existing trunking systems without undue pressure on system congestion. Customers needing more substantial amounts of airtime can be assigned to private, dedicated, conventional channels. Unique IDs are incorporated into the AVL data stream. With proper configuration of the AVL system, several separate AVL customers could be programmed on the system with the same radio ID and not be aware that they are

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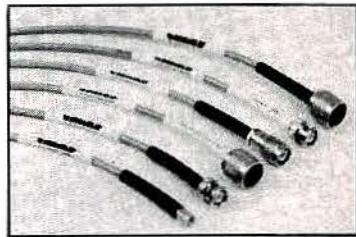
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sharing that frequency with other customers. For SMRs this allows for relieving pressure on the availability of radio IDs by selling service to multiple customers who use identical radio IDs.

Polling

The number of vehicles that can be tracked on a system depends on the frequency of *polling* each vehicle and the practical capacity of the RF system. Polling is the request made from the base to the vehicle for transmission of the position data. Polling is configured independently and dynamically for each vehicle and can be either on demand, at regular time intervals or event-initiated. Under ideal conditions, on conventional non-trunked systems, polling intervals can be cycled as frequently as every four to five seconds. Although the capacity of the AVL system allows for very short polling frequencies, most applications will be well-accommodated by conservatively set polling rates. Air time cost considerations will help customers determine the desired frequency of polling.

Operational range limitations of GPS AVL data communications over dispatch

channels are generally the same as for voice; however, tests and experiments to date have indicated slightly greater operational ranges for data than for voice. Where a customer's requirements extend to include two adjacent coverage areas, a link can be constructed that will provide transparent, seamless service in both coverage areas. The Net-Link and Easy-Link offered by IDA and the Trunk Bridge from Zetron are two examples of site-linking products currently available to the SMRs for this purpose.

Creating revenue opportunities

There is a frontier of opportunity waiting for SMRs to explore and to conquer in marketing GPS AVL to business fleet customers. Because GPS AVL incorporates familiar RF communication, there is no new technology to be learned. Basic location services can be implemented as turn-key, plug-and-play systems.

Revenue sources in the GPS AVL arena include the traditional sale, installation and servicing of radios and antennas, and providing customers with dispatch airtime. In most instances, the utility of GPS AVL will justify a separate vehicle system for AVL, potentially doubling the

units the SMR has the opportunity to sell and maintain. AVL can net incremental revenues to the SMR with little disturbance to the basic operation.

New customers introduced to the benefits of AVL may require instruction and assistance in installing, configuring and maintaining their AVL systems. The SMR can load AVL software on the customer's base computer, perform the initial configuration of the system and give basic instruction on features and benefits. The customer may elect to have the SMR be responsible for ongoing maintenance of the system. This could be provided on-site or by computer telephone communication. A maintenance program sold in the form of a service contract by the SMR is an additional new profit center.

Another service is for the SMR to function as the base, monitoring and tracking its customers' vehicles. The AVL customer would rely on the SMR to keep track of the locations of vehicles and to collect location data to be reported to the customer at a later date. This service would include responding to inquiries from customers as to the current locations of their vehicles, quick and efficient reporting of emergency alerts or otherwise advising the customer of predetermined events or conditions detected by the AVL system. The unique ID associated with AVL data would allow for several customers to be tracked on the same radio ID. Valuable service can be provided for multiple customers with frugal use of RF resources. This service is especially appropriate for arrangements where there is need for only infrequent, incidental knowledge of vehicle locations.

SMRs also can direct and dispatch customer vehicles. This dispatching service could be provided for many customers simultaneously. Processing and reporting of the data by the dispatch service could relieve customers of administrative chores and could even result in the dispatch service providing billing statements to be issued by the AVL customers to their customers or clients.

Conclusion

The marriage of the expertise and talents of SMRs with leading-edge vehicle locational technology is a natural combination for success. This is only the beginning! The future holds tremendous potential for SMRs who have the vision to embrace automatic vehicle location and mobile data communication as the next big surge of opportunity in our industry.

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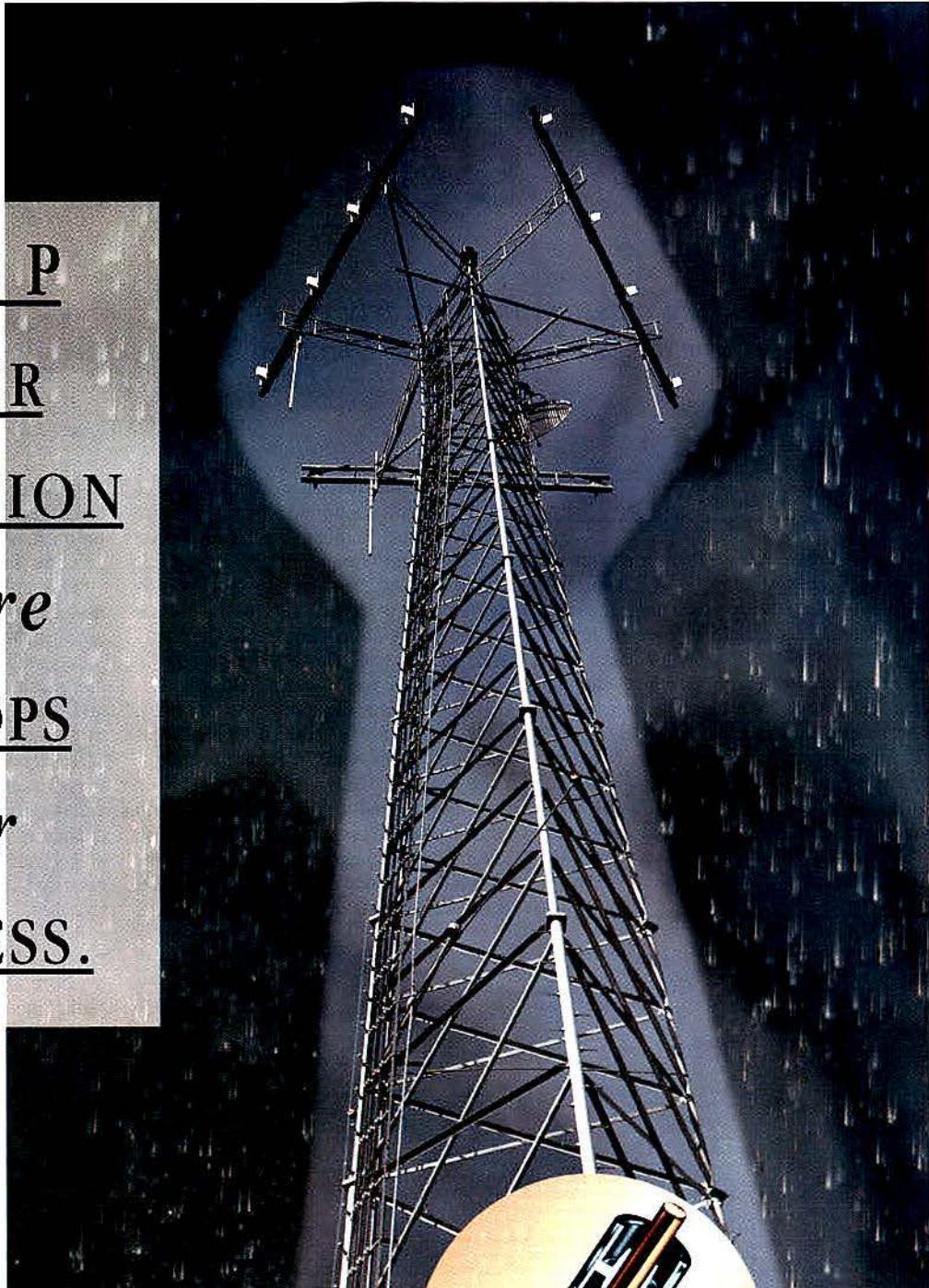
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Tone signaling over telephone lines—A technician's primer

When planning a system that will rely on telephone circuits for tone signaling, control or access, contact your telephony provider's engineering office.

by Donald E. Koehler

If your future plans call for tone signaling or control of remote base stations, polled receivers or other communications equipment, this article is sure to be of interest to you or to your technical and maintenance staff. The technical characteristics of telephone lines, both switched and "nailed up" circuits; the kind of tests frequently used by telephony providers and some simple troubleshooting you can do using imbedded telephone tones will be covered. One word of caution: al-

Koehler teaches at the University of Alaska, Anchorage.

though the information presented here is referenced to documents from Bellcore (the telephone "standard" setter of the old Bell operating companies), always check with your local provider to see what testing you may perform and what equipment voltage levels are acceptable to their specific equipment—these vary widely in some parts of rural North America.

The telephone lines that you are most likely to use in your control scheme typically are copper wires, twisted together to form "pairs." The twist in the cable is designed to reduce crosstalk between pairs within a larger cable. If you are going to run tones and digital data over the same provided pair, let the provider know about your plans. Some types of

high-speed digital data can cause severe crosstalk. These crosstalk problems can be eliminated by line conditioning. Let's see how lines are tested and conditioned.

The cable pair(s) you use will, if unterminated, appear to your equipment as a capacitor. Even if correctly terminated, cable runs over longer distances can result in the attenuation of the higher audio or control tone frequencies. This "frequency attenuation distortion" can seriously affect your control circuit. In most cases a simple lumped inductance can balance the overall passband (frequency vs. attenuation) and provide acceptable results. If extremely long distances are used, some type of amplification is required.

This amplification is provided, in analog circuits, by a device that uses a pair of hybrid coils (see Figure 1 at the left) to "split" the signal, at least temporarily, from a two-wire circuit into a four-wire circuit.

A four-wire circuit provides for a separate transmit and receive pair to boost, then the amplified signal is placed back onto the single pair of wires by means of a second hybrid coil. (See Figure 2 below left.) This method of signal conditioning has been in use for years. The only disadvantages are that the amplifier boosts both the desired signal along with any noise present on the line, singing and the possibility of echo generation caused by the hybrid coils. Checking for these "by-products" is covered later.

Connectivity to your remote site may be provided as a two-wire or four-wire switched circuit or as a permanent circuit. If the circuit is one or two pairs of wires connected between your sites without the use of switching equipment, it generally is referred to as a "nailed up" circuit. This does not preclude the telephony provider from conditioning or amplifying the line.

The "normal" passband of an unconditioned telephone line is between 300Hz and 4,000Hz—a range of frequencies that

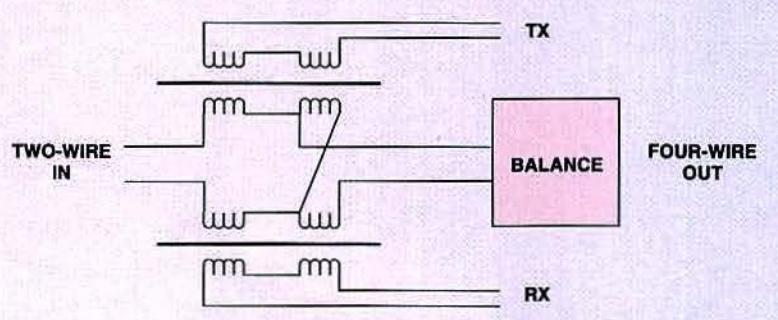


Figure 1. Using a hybrid coil to split a signal from a two-wire circuit into a four-wire circuit.

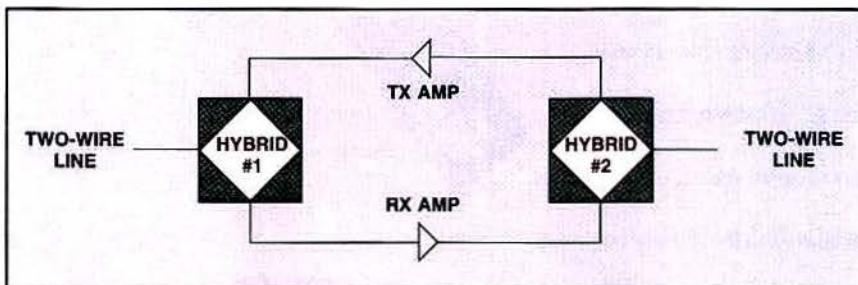
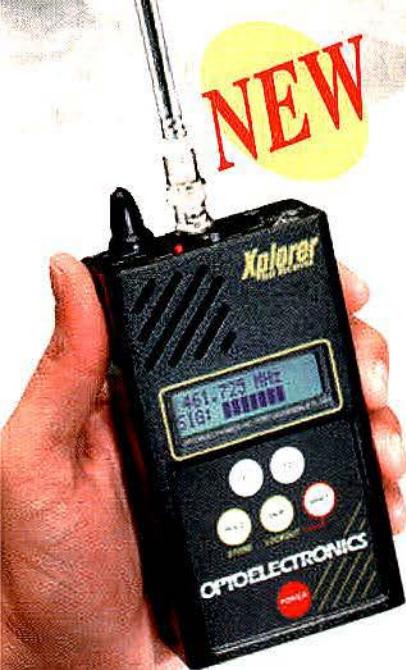


Figure 2. Boosted by a separate transmit and receive pair, the amplified signal is placed back onto a two-wire circuit using a second hybrid coil.

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should offer flat response (levels) and little distortion. If your line exceeds 9 kilofoots, line conditioning equipment may be required.

Testing and maintenance of the line is generally the responsibility of the provider. Several of the tests performed by telco technicians may be of interest to you. If the circuit is switched—that is, if it runs through a modern digital switch in the local "central office," then circuit

condition testing is mostly automated. The type of tests performed by the switch can also be performed on "nailed up" circuits with technician intervention.

The tests most likely to be of benefit to you are PAR, echo return loss and singing/singing return loss. If your needs are strictly digital data, then the bit-error rate (BER) test is the only one that is needed to test for line quality. The PAR or "peak-to-average ratio" test consists of

sending a precise set of pulses, with a known ratio of peak to average full-wave rectified voltage, into the line and measuring the resultant voltage at the far end of the circuit. Although this test will detail bandwidth, poor return loss and its attendant gain and phase distortion, the test will not define noise, jitter, IMD or other factors that can degrade control tones.

Echo on the line is the difference between the original signal and its echo, resulting from the two-to-four wire interfaces found in most central office equipment main distribution frames or transition points. Echo return loss measures loss (distortion) between 560Hz and 1,965Hz, whereas singing return loss (low) defines the distortion between 260Hz and 500Hz; and singing return loss (high) covers 2,700Hz to 3,400Hz. This is especially important if CTCSS tones must be recovered by your control equipment.

For data-only circuits, BER testing requires the use of a protocol analyzer or a



Receive only	Freq. Ranges (MHz)	N.F.	Gain Comp.	Device	Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	\$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	\$ 109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	\$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	\$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	\$ 109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	-20	Bipolar	\$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	-20	Bipolar	\$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	\$ 109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	\$ 119.95

Inline (rf switched)

SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	\$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	\$ 139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	\$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	\$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	\$ 139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	-20	Bipolar	\$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	-20	Bipolar	\$ 104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	\$ 139.95

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The tests most likely to be of benefit are PAR, echo return loss and singing/singing return loss. For digital data, the BER test is the only one needed to test for line quality.

purpose-built data test set. First, the line you use is connected back onto itself at the far end. This is called *looping*, or *loopback*, and can be performed at either the line or control end. Most modern modems and channel service unit/data service units (CSU/DSU) can be forced into a loopback with a specific tone. Then, once the loopback is established, a data stream is sent through the circuit. Errors caused by noise, jitter, phase drops or excessive distortion are quickly spotted. If the BER exceeds your requirements, call the telephony provider to initiate a trouble ticket. Working with the provider will lead to a better understanding of your needs.

Analog signaling schemes allow you to perform some simple tests prior to contacting your telephony provider. The first step, and an important one, is to record the measurements of line levels measured at your line (equipment side) termination—often called a *demarc* (short for demarcation point). Using the correct



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load, typically 600Ω to 900Ω , or a bridging transformer, measure the voltage delivered to your site with a known or standard source providing a tone at the control end of the circuit. For switched (dial-up) circuits, dial the number for the local office "milliwatt signal." This is a tone (1,004Hz) produced at a precise level—usually 1mW ($0.775\text{V}_{\text{AC}}$ @ 600Ω) and terminated correctly for the equipment in use. Measure and record this (and other tone)

signal levels at both the control and line equipment (remote) end of the circuit. Leave a record of measured levels at both the local and remote site to aid in any future troubleshooting that may be required. After all, problems seldom occur during business hours.

With record in hand, you can feed a known signal to the remote site and check for excessive attenuation. In switched circuits, a call to the "milliwatt signal" from

either end of your circuit can help to pinpoint potential problems quickly. To test for possible problems with distortion requires the use of a notch filter, signal generator, ac voltmeter and some patience. If you have access to more advanced equipment, such as a sweep generator and oscilloscope, you can perform similar tests much more quickly. By setting your sweep generator to provide a signal between 300Hz and 4,000Hz, you can monitor the results at the opposite end with your oscilloscope. This approach may trigger unwanted responses from central office equipment. Central office equipment is often controlled by tones within the voice frequency (VF) passband. To avoid trouble, check with your local provider before such tests are performed. Equipment used by most telco technicians uses as few as three, and as many as 23, separate (non-sweeping or fixed) tones to perform tests for bandwidth and distortion.

When planning a system that will rely on telephone circuits for tone signaling, control or access, contact your telephony provider engineering office to:

- determine the technical characteristics of the telephone circuits available for your use.
- discuss the type of equipment and signals you plan to install and use.
- ask what support will be available for repair of potential problems.
- find out what kind of testing you will be permitted to perform and how to best express this information to the telephony provider's technical staff.
- confirm the costs of any technical assistance required and provided, and the limits of responsibility.

Document these discussions, and provide a copy to your provider. If a problem does arise, records are always better than a memory—and much safer as well.

Acknowledgement

The Bellcore "Redbook" of engineering standards was used as a reference in the preparation of this article.

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Recommended reading:

Clarke, Martin P., *Networks and Telecommunication—Design and Operation*, John Wiley and Sons, ISBN 0-471-92799-6.

Visit the Bellcore web site, (www.bellcore.com), and the "Telephony 101" document on the Northern Telecom site (www.nortel.com) to learn more about the public switched telephone network (PSTN).

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Circle (29) on Fast Fact Card

Servicing tips for the Bravo family of pagers

Identification, frequency changes, logic board modifications and testing, and POCSAG generators are discussed.

By David Ludvigson

Around the pager service bench, boards sometimes seem to accumulate. Here's how to quickly distinguish the Bravo receiver board from the Bravo Plus/Express receiver board. At the end of the board, next to the "jungle chip" on the Bravo receiver, are usually some five or six components. At the same location on the Bravo Plus/Express receiver board, there are just two components.

Keep in mind that these two receiver boards are *not* interchangeable. There will be no damage inflicted if they are accidentally substituted for each other, but there will be no output at test point M1 when the "wrong" receiver board is used.

Crystal issues: co-channel operation

Problem. You need to change the frequency of a Bravo pager by a single channel. Here's how, with an interesting twist.

In many metropolitan areas, numerous paging companies operate. In some cases, the available capcode and number combinations simply do not match the frequency to which the pager is tuned.

Usually, this is overcome by means of changing crystals—but then, there are times you can get lucky.

After experiencing poor performance from one airtime supplier, I discovered that the tuning slug in the Bravo 930MHz series pagers (all of them) was capable of tuning to the next channel *down* from the marked frequency of the crystal. Thus, a pager operating at 931.7125MHz could easily tune down the 250kHz required to operate at 931.6875MHz.

The technician using this technique will discover that as the slug of the oscillator coil is tuned *clockwise* (as viewed from the foil-side of the board),

the next-lower channel becomes available. Note that the slug nears the limit of the core length, making such adjustments "iffy." To improve the fit, the slug sometimes can be removed (from the top), and a piece of cotton thread can be placed down the core. The thread acts as a "snugging" device when the slug is reinserted into the core.

When using this "trick," be aware that "warping" a crystal in this manner might make the oscillator more sensitive to temperature and environmental changes, particularly when used with the 17.9MHz IF versions of these receiver boards.

Crystal issues: "true" conversions

The logic board in the Bravo is often "stuck" at 512bps when the customer needs a 1.200bps unit. Here's how to convert the Bravo into what I call a "cricket."

A customer's pager is "stuck" between two worlds—the bps rate available from the airtime supplier and the limitations of the pager. Until I tried a simple modification, many of my customers were "forced" into purchasing something new—even though their pagers worked just fine at 512bps.

Within the Bravo is a crystal-controlled oscillator on the logic board that determines the operating speed of the microprocessor. The crystal frequency is 2.048 times the bps rate—at 1.200bps the crystal frequency is $2,048 \times 1,200$, or 2.4576MHz. The 512bps logic boards have a crystal at 1.048576MHz, although at 2,400bps, the oscillator crystal would have to be $2,400 \times 2,048$, or 4.9152MHz.

The Bravo logic board is easy to modify. Simply remove the existing crystal and replace it with a suitable crystal using the math presented above.

There are a few limitations. Modified in this manner, the logic board will work only when moved up one "step"—you can move from 512bps to 1,200bps (or 1,200bps to 2,400bps), but the 512bps board cannot

handle a direct conversion to 2,400bps, because the bandpass filter will not handle the higher data-rate speeds. The second limitation is one of customer convenience. The "beep" coming from the internal speaker is going to change in frequency—from a nominal 3.2kHz tone to something over 6kHz. Further, the on-off cadence is also going to become twice as fast. Hence, the name "cricket."

When programming the modified Bravo, there are no special instructions—just program as usual. The vibrator alarm will operate for roughly half the time it did previously. Although this is not a modification for everybody, it does provide adequate service without the expense of a new unit.

(Note: The loading capacitance and mode for these crystals should be 18pF–20pF, series-resonant mode. Case styles should match, or be similar, to those removed. Moreover, the described modification is *not* recommended by Motorola.)

Testing logic boards

The following procedures may be used to test Bravo, Bravo Plus, or Bravo Express logic boards (see Figures 1 and 2 on page 36) using Ramsey COM-6 test equipment:

Testing the logic board for the Bravo:

1) Place the logic board in an empty Motorola case, noting the "Qxx" number on the microprocessor chip.

2) Place a 1.5V battery in the case and close the battery door.

3) Place the pager in test mode. Preset the COM-6 to the appropriate capcode, along with a preloaded message.

4) Place the *negative clip* from the COM-6 at *battery negative*.

5) Set the generator to "normal" signal format output (red light off for DATA INVERT button).

6) Place the "hot" lead of the COM-6 output directly on pin 6 of the interconnect

Ludvigson is a technician in Houston.

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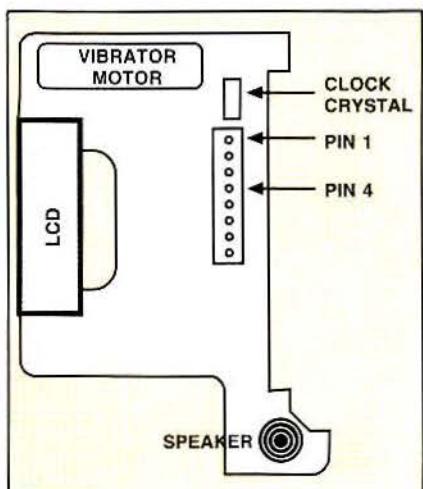


Figure 1. Bravo and Bravo Plus interconnection pin identification.

block (pin 1 is nearest to the speaker).

7) Generate the appropriate capcode and a preloaded message by using the SEND button.

8) With the Bravo in test mode, the logic board should emit a single beep with a momentary light. This tests the entire circuitry. A further test would be to place

the logic board in "fully operational" mode (just turn it on without holding any buttons). It should give a full response using procedures 6 through 7.

Testing the logic board for the Bravo Plus and Bravo Express:

1) Read the capcode on the Bravo Plus/Express interface.

2) Follow procedures 2 and 3 given for testing the Bravo.

3) Place the negative clip from the COM-6 at battery negative.

4) Set the generator to "inverted" signal format output (red light "on" for DATA INVERT button).

5) Place the "hot" lead of the COM-6 output directly on pin 4 of the interconnect block. (Pin 1 is nearest to the clock crystal in the Bravo Express.)

6) Generate the appropriate capcode and a preloaded message by using the SEND button.

7) With the Bravo Plus/Express in test mode, the logic board should emit a single beep with a momentary light. This tests the entire circuitry. A further test would be to place the logic board in "fully operational" mode (just turn it on without holding any buttons). It should give a full response using

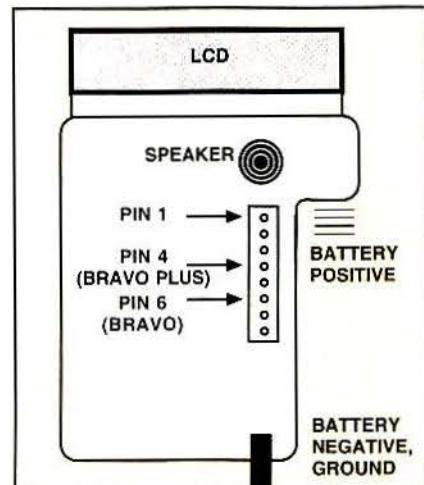


Figure 2. Bravo Express interconnection pin identification.

procedures 5 through 6.

Other POCSAG generators

The techniques outlined above also work with just about any POCSAG or Golay signal generator. When using a KNS-Cushman generator, the output level potentiometer will need to be set to

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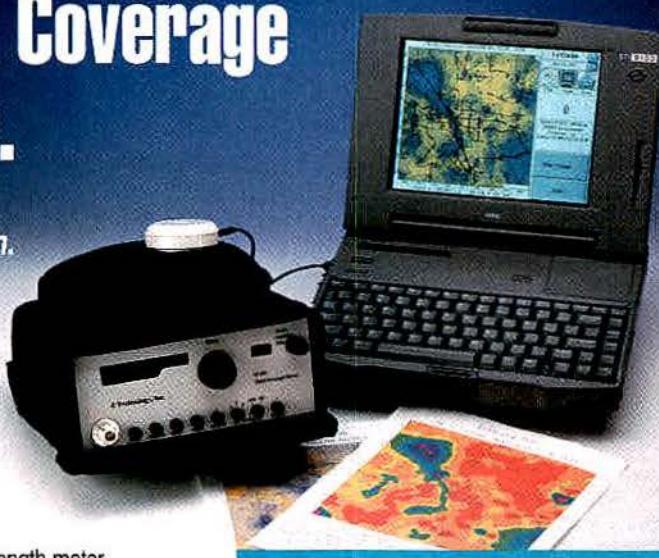
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Surfing for servicing assistance

Several interesting programs that convert an IBM-compatible computer into a POCSAG encoder and decoder are now available. These may be obtained from:

Robert Whitaker, P.O. Box 1266, Victoria, TX 77902-1266, phone 512-573-0821.

Demonstrations and technical notes are available on the World Wide Web at:

<http://www.select.demon.co.uk/pocsag.html>
and

<ftp://ftp.demon.co.uk/pub/ham/scanners/pe-200.zip>

Further information about frequency-shift-keying techniques and POCSAG can be found in the handbook compiled by Mike Curtis. It is available at:

<http://inss.1.etec.uni-karlsruhe.de/~df0uk/96man2.txt>
or
<http://hamgate.cc.wayne.edu/packet/9600man.txt>

—David Ludvigson

600mV-1.0V, peak-to-peak, at the output probes. The value stored in register 1 of the KNS generator determines the normal, or inverted polarity of the output signal, so to test the Bravo, do the following:

1) Perform a "0 store 1" to set the KNS

generator to normal. Then perform a CLR.

2) Determine the "speed" of the microprocessor in the Bravo, and set the "0" register to that speed. For example, 1,200bps POCSAG would be "5 store 0" (4 = 512bps, and 6 = 2,400bps). Perform a CLR.

- 3) Prefix your capcode with a "1."
- 4) Enter the capcode.

[Therefore, a capcode of "1234567" would display as "11234567."]

- 5) Using the same testpoints outlined above ("hot" on pin 6 of the interconnect lock, and GND on the battery negative tab), generate the capcode by pressing SND.

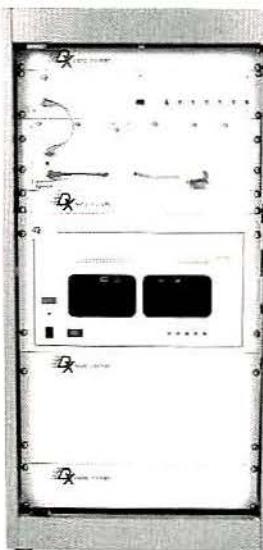
Similarly, when testing the Bravo Plus or Bravo Express, the only differences involve reversing the signal polarity (1 store 1), and the "hot" side of the generator now goes to pin 4 of the interconnect block. As before, the pager's response depends on whether the unit is in "test mode" or "fully operational."

Whether using the Ramsey COM-6 or any other POCSAG/Golay generator, there may be some slight "chance" of a "short" between the input to the decoder board or chip. For safety's sake, isolate the "hot" spot side of the signal generator with a 0.1 μ F capacitor before touching the appropriate pin on the interconnect block.

These procedures vastly simplify the testing the logic boards in the Bravo pagers. They are performed in the "half-shell" of the pager, and do not specifically require the use of the push-button inserts.



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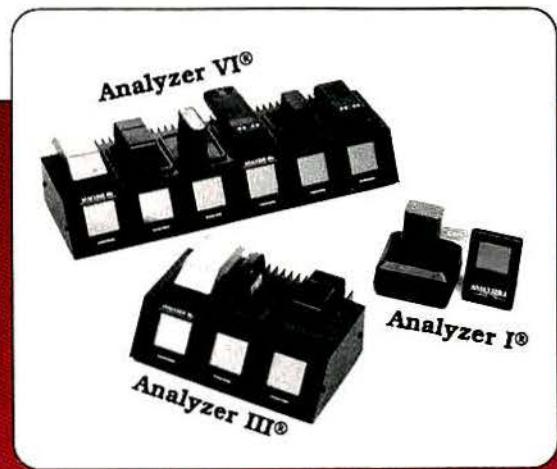


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Coverage prediction for digital mobile systems

Part 2—Physical modeling, such as ray-tracing, offers the best way for predicting coverage and error rate performance in current and future digital systems.

by Harry R. Anderson, Ph.D., P.E.

Part 1 of this article contrasted empirical and physical models for propagation modeling (January 1997). This month, the propagation mechanism and the prediction of digital errors are examined.

Propagation as a channel filter

An instructive and useful way to look at the propagation mechanism is to consider it as a filter, and the propagation path itself as a channel containing this filter, as illustrated in Figure 1 below left. The notations $h(t)$ and $H(f)$ shown in Figure 1 are standard engineering terms for the *transfer function* of the filter. The transfer function is simply a way of describing what happens to the signal as it passes through the filter.

The propagation channel filter transfer function certainly has attenuation (the familiar path loss), but it also has other characteristics that can have important effects on the signal that is detected at the receiver.

How do we find the other characteristics of this filter? One approach is to find

all the ways the signal can travel from the transmitter to the receiver, rather than just assuming it gets there via a single path as discussed in Part 1 of this article. If we take into account all the ways the signal arrives at the receiver, we have completely described the filter transfer function. An approach to the problem is the multiray or "ray-tracing" method.¹ The multiray concept is illustrated in Figure 2 below right. Signals leaving the transmitter encounter a wide variety of objects in the propagation environment including buildings, mountains, the ground and vehicles. The signals can "bounce" (reflect and diffract) off these objects and get to the receiver via many paths. This is multipath propagation, and it causes the familiar signal fading at the receiver which every mobile radio engineer has observed.

Using some mathematics, we can develop a way to use these rays to find the transfer function, $h(t)$, of the channel filter. First, let's look at the case for the single path to the receiver. In this situation we have only path loss so we can write a simple equation for the signal

strength at the receiver. Under these circumstances, the signal at the receive antenna terminals, E_r , would be the same as the signal at the transmitter, except weaker. This can be written as shown in Equation 1 [See sidebar on page 42], where E_r is the (complex) electric field voltage or magnetic field current at the receive antenna, E_t is the magnitude of the transmitted signal (voltage or current), ω is the carrier frequency in radians, and t is time. The multiplicative factor, A , is the propagation loss, while θ is some phase delay or phase shift introduced by the channel. The expression

$$\exp(-j\omega t + \theta)$$

is just a convenient way to describe the transmitted carrier wave in this case. For simplicity only the electric field will be represented in the following equations with the understanding that there is an associated magnetic field.

If the channel is now considered as a filter with some lowpass impulse response, that impulse response would be given by Equation 2, where the " $\delta(t-\tau)$ " means there is impulse in the channel response at time $t=\tau$. A sinewave signal at frequency ω leaving the transmit antenna would arrive at the receiver reduced in amplitude by factor A , shifted in phase by θ and delayed by τ seconds where the

¹Ray-tracing is the most common approach here, but other electromagnetic field calculation methods, such as FDTD or method-of-moments, that attempt to provide a complete description of the signal at the receiver, could potentially be used.

Anderson is president and chief executive officer of EDX Engineering, Eugene, OR.

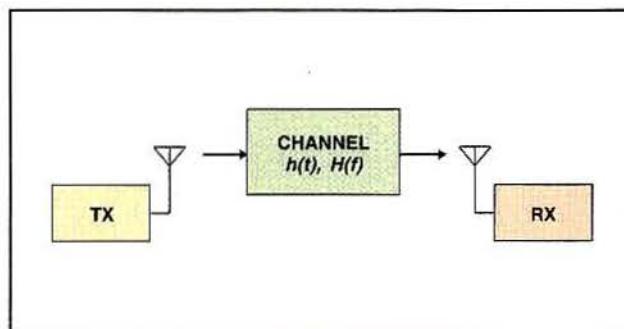


Figure 1. Propagation channel model.

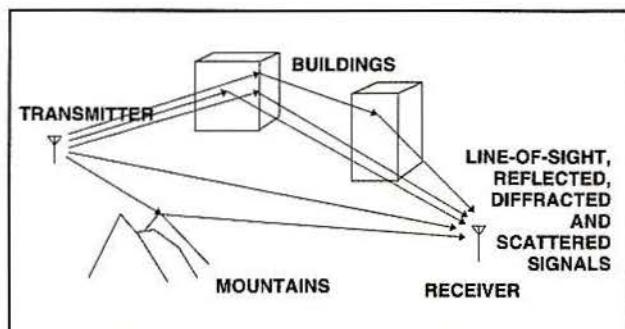
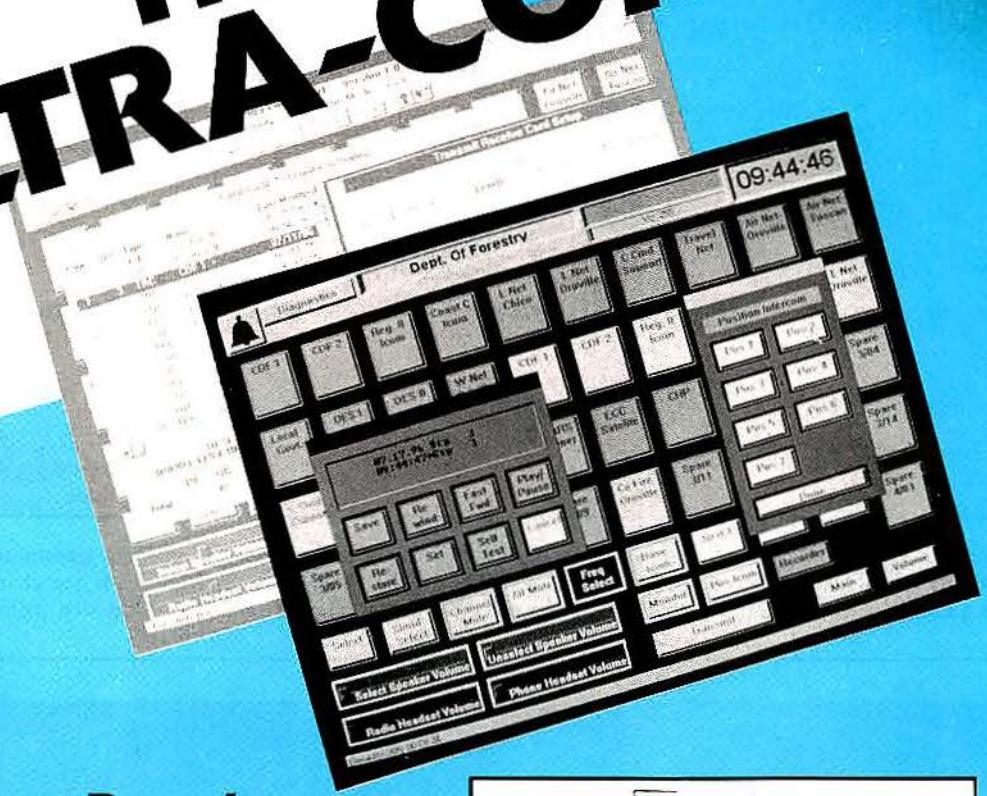
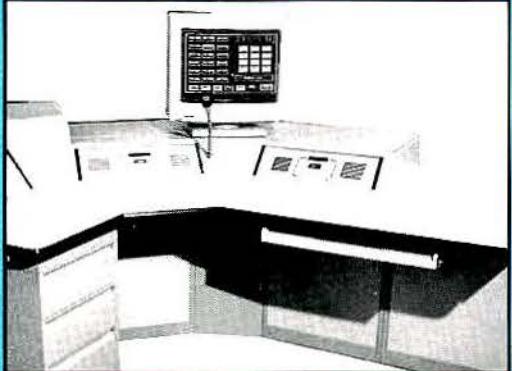


Figure 2. Channel model of multipath signals arriving at the receiver.

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$$[1] \quad E_r = AE_t \exp(-j\omega t + \theta)$$

$$[2] \quad h(t) = A\delta(t - \tau) \exp(-j\theta)$$

$$[3] \quad h(t) = A_1\delta(t - \tau_1) \exp(-j\theta_1) + A_2\delta(t - \tau_2) \exp(-j\theta_2)$$

$$[4] \quad h(t) = \sum_{n=1}^N A_n \delta(t - \tau_n) \exp(-j\theta_n)$$

$$[5] \quad h(t, p_1, p_2) = \sum_{n=1}^{N(p_1, p_2)} A_n(p_1, p_2) \delta(t - \tau_n(p_1, p_2)) \exp(-j\theta_n(p_1, p_2))$$

$$[6] \quad h(t, p_1, p_2) = \sum_{n=1}^{N(p_1, p_2)} A_n(p_1, p_2) \delta(t - \tau_n(p_1, p_2)) \exp(-j\theta_n(p_1, p_2) + \Delta\theta_n(p_1, p_2))$$

$$[7] \quad h(t, p_1, p_2, \omega) = \sum_{n=1}^{N(p_1, p_2)} A_n(p_1, p_2, \omega) \delta(t - \tau_n(p_1, p_2)) \exp(-j\theta_n(p_1, p_2, \omega))$$

$$[8] \quad \sigma_\tau = \left[\sum_{n=1}^N (\tau_n - \bar{\tau})^2 p(\tau_n) \right]^{\frac{1}{2}}$$

$$[9] \quad \bar{\tau} = \sum_{n=1}^N (\tau_n) p(\tau_n)$$

$$[10] \quad p(\tau_n) = \frac{A_n^2}{\sum_{n=1}^N A_n^2}$$

delay is a direct function of the path length from the transmitter to the receiver. Such a model of the transmission channel

is applicable for free-space propagation conditions where the signal energy arrives at the receiver directly (via one path) from

the transmitter.

If the channel consisted of two transmission paths for the transmit energy to

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arrive at the receiver (for example, with the addition of a single ground reflection), the channel impulse response would be the sum of the effect of the two paths as shown in Equation 3.

This is the impulse response of the so-called "two-ray" channel model. If we have N possible transmission paths, $h(t)$ transforms as shown in Equation 4. This is the channel impulse response to the receiver at a particular coordinate point in space, $p_2(x_2, y_2, z_2)$, from the transmitter located at some other coordinate point, $p_1(x_1, y_1, z_1)$. The more general impulse response as a function of this geometry can thus be written as shown in Equation 5, where the number, amplitude, phase and time delay of the components of the summation are a function of the location of the transmit and receive antenna points in the propagation space.

The channel impulse response given by Equation 5 is for a single static point in space. For mobile communication, the receiver is often moving, and that motion can affect the phase relationship of the components of Equation 5 in a way that may be important to digital data being transmitted over the channel. This motion

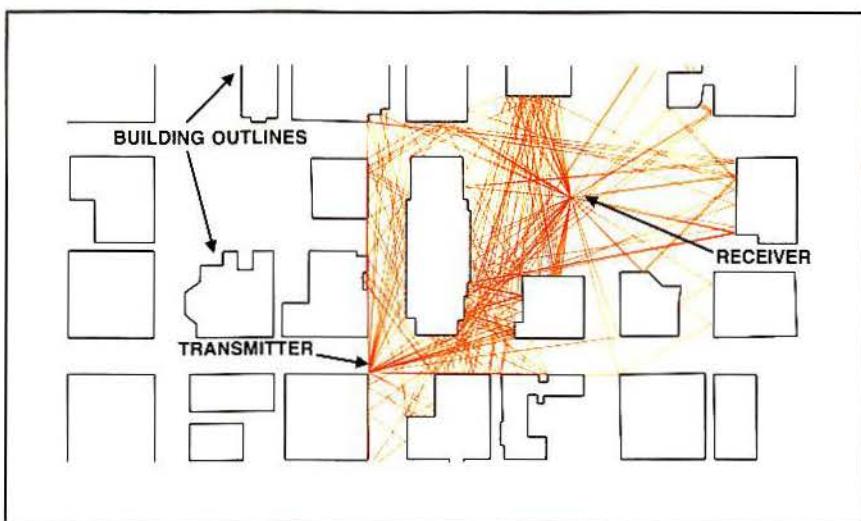


Figure 3. Ray-tracing study in an urban area.

will result in a frequency or Doppler shift of the received signal that will be a function of speed and direction of motion, and the angle of arrival of the signal energy. Equation 5 can be modified to include Doppler shift and thus account for this motion as shown in Equation 6, where

$\Delta\theta_n$ is a phase displacement due to the motion.

It should be kept in mind that this is motion of either the transmitter or receiver *relative to every other element in the propagation environment*. The transmitter or receiver may be fixed, but a

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signal from a moving reflection source (such as a moving bus) may result in a nonzero $\Delta\theta_n$ for a particular component of Equation 6. For a mobile receiver,

$$\Delta\theta_n = \left(\frac{2\pi v t}{\lambda} \right) \cos(\varphi_n - \varphi_v)$$

where φ_n is the arrival angle of the n^{th} ray component, v is the speed of motion, φ_v is the direction of motion, and λ is the wavelength.²

In general, the amplitudes, A_n , and phase shifts, θ_n , will be functions of the carrier frequency, ω , because they are controlled by the interaction of the transmitted energy with the features of the propagation environment. Inserting the frequency dependence into Equation 5 produces Equation 7.

We can now apply this approach to a practical situation. Figure 3 on page 43 shows an overhead drawing of a downtown area with several buildings. The multiple rays from the transmitter to the receiver are shown reflecting and diffracting off the buildings. (The author's article describing the methods involved in such "ray-tracing" is listed in the references.) If we were to plot the channel filter impulse response for this case, as given by Equation 7, we would have the graph shown in Figure 4 at the right. This comprehensive description of the propagation channel filter (often called a power delay profile) includes not only path loss information but several other characteristics of the propagation channel. Now that we have the filter response, how

²The ray angle of arrival and the direction of mobile motion can both be interpreted here as azimuth angles relative to true north.

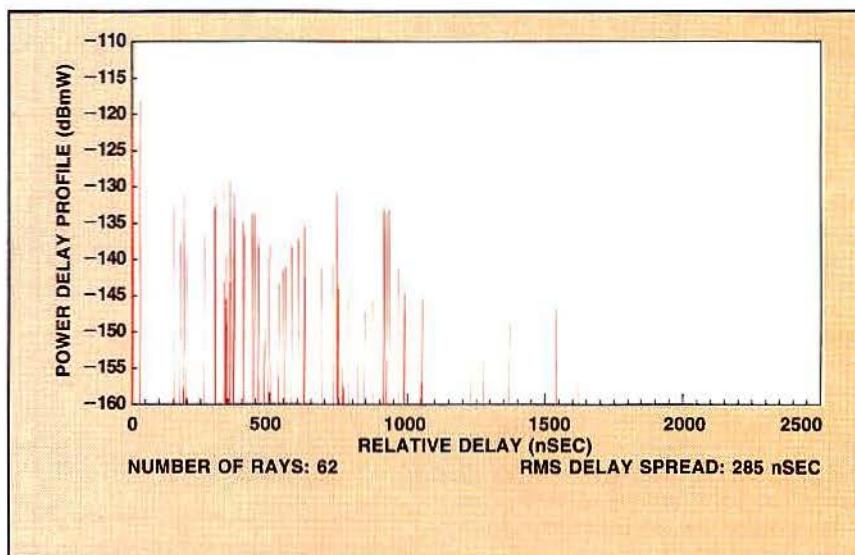


Figure 4. Channel impulse response for propagation channel in Figure 3.

do we use it to predict coverage or performance in a digital system?

Digital errors due to multipath

Errors in a digital system occur when the receiver mistakenly interprets a 0 for a 1 or vice versa. The receiver needs to make a decision about which value it has received. If the only signal the receiver has to work with is a perfect replica of the transmitted signal, it could make this decision flawlessly every time, and there would be no errors. But it doesn't have a perfect replica to work with. First, and most common, there is noise introduced by the receiver and, perhaps, external sources. As we've determined from Equation 7 and Figure 3, there are also a lot of

other signals arriving at the receiver that can confuse the detection process and cause an error. The effect of noise on the error rate performance is well-known and exhaustively treated in communication engineering textbooks. We will thus focus on the errors due to the multipath signals.

Let's say we want to transmit a series of digital pulses or symbols over a propagation channel like that shown in Figure 4. We will assume our digital pulse has been smoothed off with a filter at the transmitter so it uses less bandwidth. When it gets to the receiver it looks like the first pulse waveform in Figure 5 above. There is a strong peak in the signal that comes from the strongest ray arriving at the receiver, but there are also other

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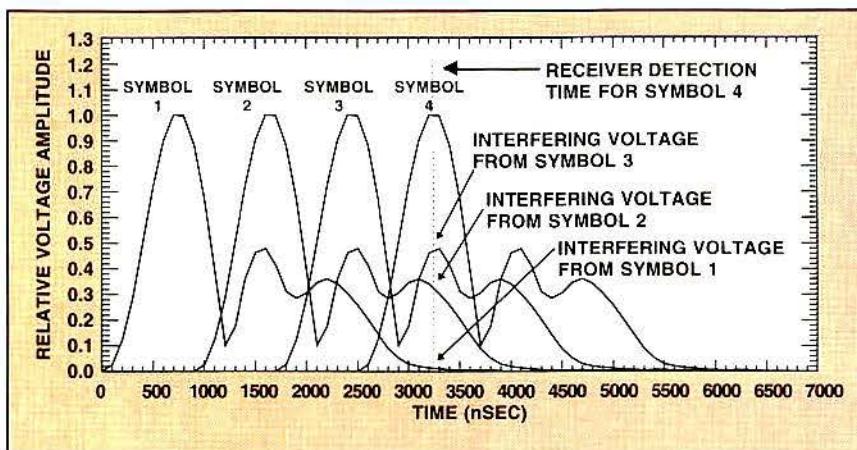


Figure 5. Inter-symbol interference in transmitted symbol 4 due to previously transmitted pulses.

peaks in the signal due to reflected signals arriving at some later time.

Now, what happens when we send a second pulse, and a third and a fourth? As Figure 5 shows, when the receiver tries to detect the fourth pulse, the decision is corrupted by reflected energy from pulses transmitted earlier. This is known as inter-symbol interference (ISI). For a given data rate and propagation channel re-

sponse, it can result in error rates that make the signal totally unusable even if the average signal power is more than adequate to overcome errors due to receiver noise. You could raise your transmitter power by a factor of 100 and your received data would still be full of errors!

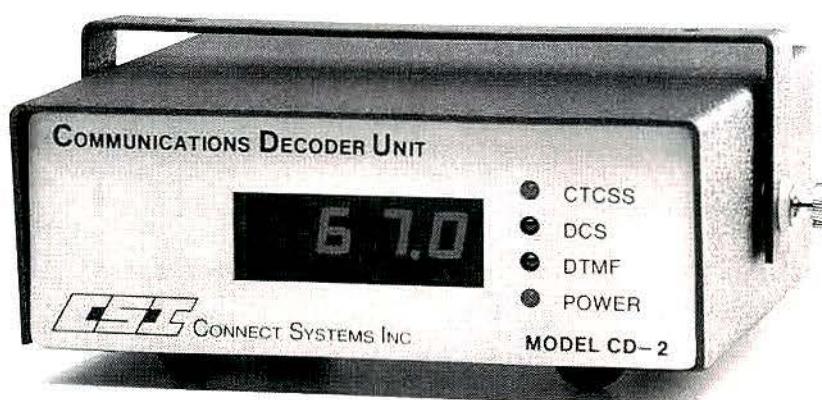
Because increasing transmitter power doesn't reduce these errors, the unfortunate misnomer describing them as "irre-

durable errors" is sometimes used. In fact, using various techniques in the receiver, such as channel equalizers, many multipath-related effects can be reduced before the signal reaches the decision-making process. A common example is the European digital cellular system called GSM, which has a data rate of about 270 kbps and uses an equalizer to improve performance in multipath conditions. Even more sophisticated are CDMA cellular systems, that use so-called RAKE receivers where the multipath energy is actually *constructively combined* to improve overall fading performance. On the other end of the scale is a European short-range telephone technology called DECT that has a data rate of 1 Mbps but uses no equalizer. DECT systems are known for having performance problems in multipath urban areas even when the signal strength at the receiver is well above the level needed for acceptable error rates if only noise were present.

An approach to explicitly calculating error rates for this type of inter-symbol interference requires detailed knowledge of the multipath components. For this reason, some simplified ways of describing the degree of multipath in the channel have

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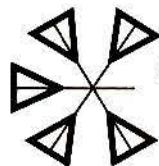


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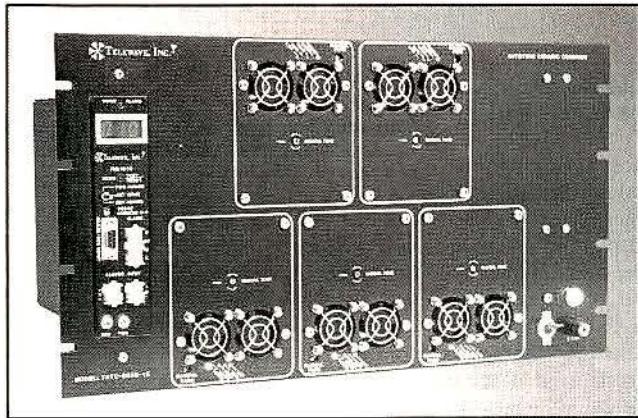
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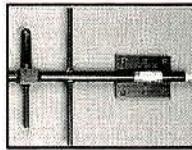
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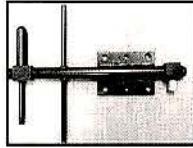
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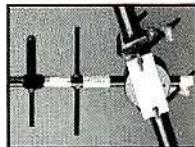
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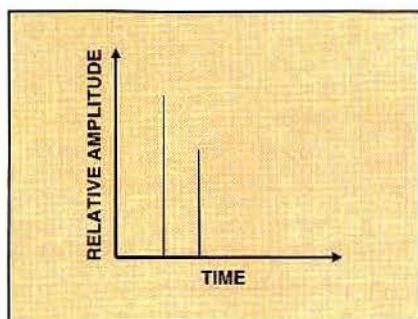


Figure 6. Response of a channel with a high error rate dominated by multipath.

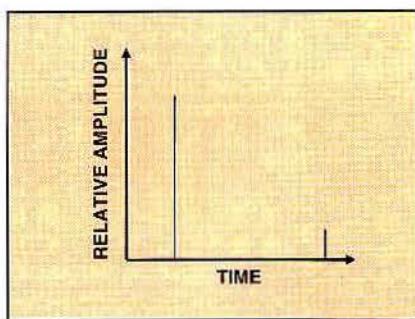


Figure 7. Response of a channel with a lower error rate controlled primarily by noise.

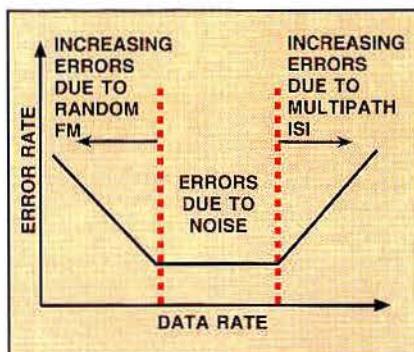


Figure 8. Error rate trends for digital mobile systems with propagation channel multipath and random FM effects.

been devised. One of the most common is RMS delay spread. The RMS delay spread, σ_T , is a statistical measure of the amount of time dispersion, or spreading, found in the multipath signal. Formally, it is calculated as the second central moment of a power delay profile such as that illustrated in Figure 3.

The RMS delay spread, σ_T , is calculated as shown in Equations 8, 9 and 10. A_n is the amplitude of ray n , τ_n is the time delay to ray n , and N is the total number of rays.

Using a single number like RMS delay spread to find error rates is often misleading, because the statistical averaging process glosses over important details about when the multipath energy arrives and what its magnitude and phase are. These factors cannot be addressed looking at RMS delay spread alone. As an example, Figures 6 and 7 above show two simple power delay profiles with two rays each. One has a strong echo delayed a short period of time after the main signal; the other has a much weaker multipath echo delayed a much longer period of time. Both channel responses could have exactly the same RMS delay spread value, but by using comprehensive analysis it

can be shown that the channel in Figure 6 will produce a high error rate dominated by multipath, and the channel in Figure 7 will have a much lower error rate controlled primarily by noise. For this reason, convenient measures of channel time dispersion like RMS delay spread should be used with caution and recognized for the significant approximations they represent.

As mentioned above, the data rate is important in determining whether multipath will cause errors. Reviewing Figure 5, if we envisioned a lower data rate

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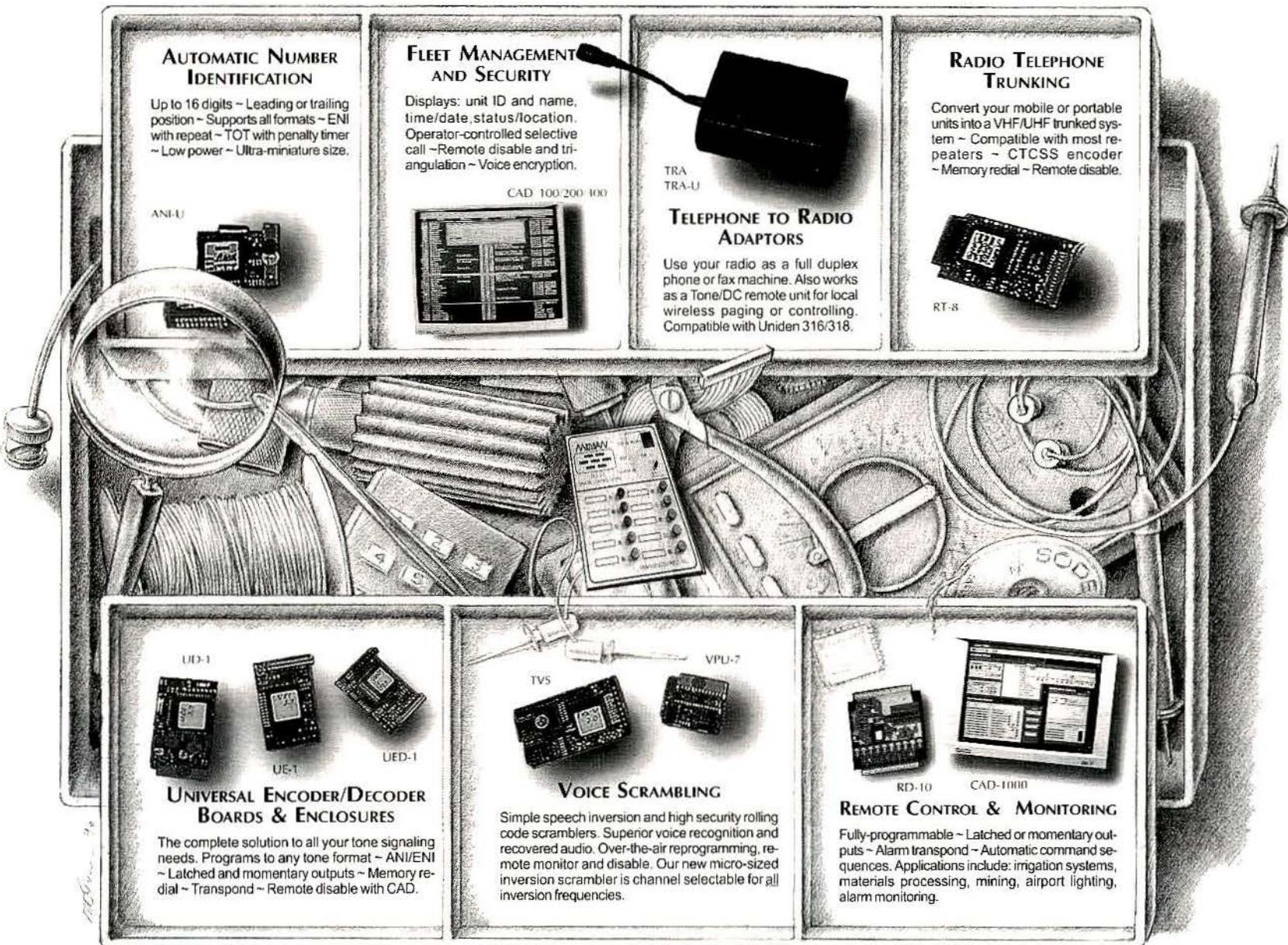
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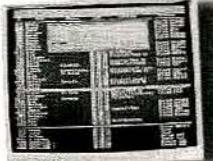
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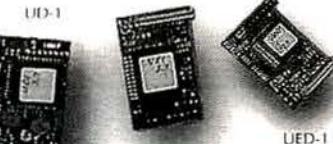
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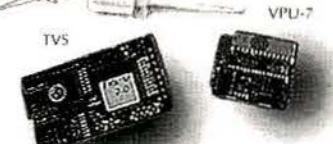
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(much greater pulse width), then all of the multipath signals would have come and gone before the decision time for the next pulse, and no errors would occur due to multipath. Depending on the data rate and the time delays for the multipath, there may or may not be errors due to this effect. For reflections along city streets, multipath delays on the order of several hundred nanoseconds may occur. With longer range systems, reflection paths from mountains may result in path delays of several microseconds. Indoor wireless systems where multipath comes from reflections off relatively closely spaced interior walls, delay times on the order to 10 to 100 nanoseconds are found. Using RMS delay spread (a quantity in time), a common rule-of-thumb says that if the RMS delay spread is greater than $1/5$ the time between the digital symbols or pulses, then errors due to multipath may be significant if no equalizer or other correction device is used in the receiver.

Random FM and doppler shift errors

Again referring to Figure 5, if we envision even lower data rates where all multipath reflections have died out, you might think that no errors would be introduced in the system due to the propagation channel filter. If the receiver is stationary (and the propagation environment is unchanging), that's true. But if the receiver is moving, another kind of error can occur that actually gets worse as the data rate is lowered.

Errors due to random FM arise in narrowband transmissions due to the phase shift of the carrier from one symbol to the next. If the data transmission rate is high, the amount of phase change that is possible from one symbol to the next, even with high mobile speeds, is still very small, so that errors due to random FM are not important compared to errors from amplitude fading in noise and errors due to intersymbol interference. For coherent detection, depending on the receiver carrier reference recovery techniques, the random phase changes can be tracked so that errors due to random FM are minimized or reduced to zero. Random FM errors are therefore of primary concern for mobile systems with relatively low data rates that employ differential modulation and detection techniques.

The usual analysis of random FM errors assumes that the signal is arriving from a single direction and that the mobile is moving in a direction ϕ relative to the arrival angle of the signal. Under these conditions, the Doppler frequency f_d (frequency shift) for a given mobile speed is

$$f_d = \frac{v}{\lambda} \cos\phi$$

where v is the speed of the mobile in meters per second. In determining error rates, the traditional assumption is that the worst case Doppler frequency,

$$f_d = \frac{v}{\lambda}$$

occurs and leads to an error rate that will depend on the modulation type. In a complex environment with energy arriving from many different directions, as illustrated in Figure 3, the rate of phase change, and hence frequency deviation, can vary considerably. In fact, a phase change of 180° can occur in deep fades over an arbitrarily short distance increment resulting in a possibility of infinite frequency deviation.

Rather than make assumptions about random FM deviation, the site-specific physical ray-tracing channel model provides detailed information about the arrival angles of signals at the mobile unit. The specific nature of the phase shift may be estimated and used to find f_d . To simplify the analysis, an average value of f_d can be found and used in a way similar to RMS delay spread to estimate when errors due to random FM become important. For this purpose the term $f_d T_s$ is used, where T_s is the duration of the transmitted symbol. The term $f_d T_s$ is an angle error and has the units of cycles. For example, an $f_d T_s$ of 0.1 represents a phase error introduced by the channel of 36° .

When considered together with the errors due to intersymbol interference, the overall error rate picture looks something like the drawing in Figure 8 on page 48. For a given signal-to-noise ratio, modulation type, propagation channel and mobile speed, as the data rate increases, the errors increase due to ISI. As the data rate decreases, the errors increase due to random FM. In between, the error rate is largely a function of noise.

Conclusions

The contrast between empirical measurement-based models, as discussed in Part I of this article (January 1997), and physical propagation models for predicting the coverage of digital mobile systems has been presented. While empirical models are simple, they do not explicitly take into account many important elements of the propagation environment, and they do not currently include information about channel delay spread or random FM, which are important in predicting error rates in many kinds of digital systems.

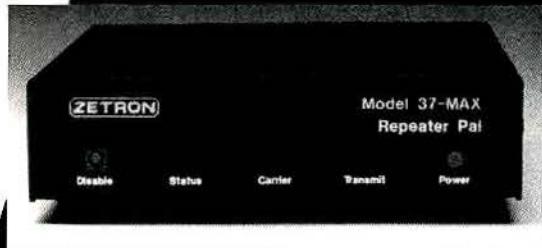
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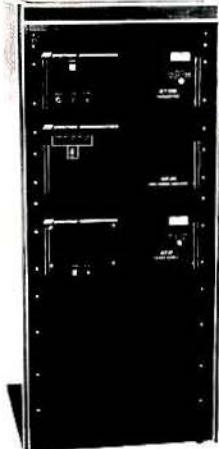
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form of ray-tracing offer a means of acquiring the necessary propagation information for predicting the performance of digital systems in any given environment. However, to make predictions, physical models rely on detailed descriptions of the environment and require relatively intensive calculations. Ever-increasing computer processor power and storage space for data make the calculations required by physical models less burdensome. Physical modeling such as ray-tracing, therefore, offers the best way for predicting coverage and error-rate performance in current and future digital systems. A software prediction tool, called EDX SignalPro, developed by our company, offers physical modeling calculations for such digital system design.

The digital system performance results presented here have generally assumed that no techniques are used in the receiver or system to combat the linear distortions caused by the propagation channel. With modern receiver design and the increasing economic feasibility of using sophisticated digital signal processing (DSP) chips in handsets, long-known techniques for countering channel impairments can now be widely employed; nevertheless, it will remain important to model the channel accurately to gain insight into the magnitude of channel impairments, which must be addressed by hardware and system designs, and to assess the overall efficacy of those designs.

References

- Anderson, H.R. "A Ray-tracing Propagation Model for Digital Broadcast Systems in Urban Areas," *IEEE Transactions on Broadcasting*, Sept. 1993.
- Anderson, H.R. "Site-specific BER Analysis in Frequency-selective Channels Using a Ray-tracing Propagation Model," *Proceedings of the 1994 Globecom Conference, San Francisco*, Dec. 1994.
- Balanis, C.A. *Advanced Engineering Electromagnetics*. John Wiley, New York, NY, 1989.
- Code of Federal Regulations Title 47, FCC Rules*, Part 73.313, U.S. Government Printing Office.
- Hata, M. "Empirical Formula for Propagation Loss in Land Mobile Radio Services", *IEEE Transactions on Vehicular Technology*, Sept. 1981.
- Jakes, W.C. *Microwave Mobile Communications*. IEEE Press, Piscataway, NJ, 1994 (re-published).
- Okumura, Y. et al. "Field Strength and its Variability in VHF and UHF Land-mobile Radio-service," *Rev. Elec. Commun. Lab.*, Sept.-Oct. 1968.
- VHF and UHF propagation curves for the frequency range 30 MHz and 1000 MHz. ITU-R. Recommendation 370-6, 1994 PN Series Volume, Propagation in Non-Ionizing Media. 1994.

(continued from page 8)

(L) and distance (D) for any frequency. You must enter the velocity factor (V) of the transmission line. The calculations are only valid for matching a 75Ω ($75 \pm j0$) load (antenna) to a 50Ω receiver, transmitter or other 50Ω device.

The data in the sidebar at the right show that a 4.7" open stub is placed at a distance of 27.35" from the antenna feedpoint to achieve a match between the 75Ω antenna and the 50Ω device to which it is connected. The center frequency is 155MHz. The matching stub provides a VSWR of 1.1:1 or less over the frequency range of 148MHz-162MHz and a VSWR of 1.2:1 or less over the frequency range of 140MHz-168MHz.

To illustrate the use of the formulas in the sidebar on page 54, suppose that a 75Ω antenna such as the dipole must be matched to a 50Ω device at a frequency of 159MHz. The transmission line is 50Ω low-density foam coax with a velocity factor of 0.79. If the tuning stub is to be the open type then formula (1) is used. Substituting, we have:

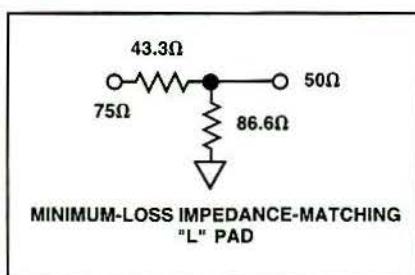


Figure 3. This simple resistor 'L' matching pad can be used to match a 75Ω antenna to a 50Ω system. This is a *minimum loss* pad and has a loss of 5.7dB. Such pads can be easily constructed for use at lower frequencies. For use at higher frequencies, commercially manufactured pads are recommended.

$$D = \left[\frac{(11811)(0.79)(0.359)}{159} \right] = 21.067 \text{ inches}$$

Next, the length (L) of the open stub is determined by using formula (2). Substituting, we have:

$$L_O = \left[\frac{(11811)(0.79)(0.062)}{159} \right] = 3.64 \text{ inches}$$

Open stub:

Frequency: 155MHz
Distance from stub to feedpoint: 27.35 inches or 0.359λ
Length of open stub: 4.70 inches or 0.062λ
Bandwidth for VSWR of $\leq 1.1:1$: 148MHz-162MHz
Bandwidth for VSWR of $\leq 1.2:1$: 140MHz-168MHz
Velocity factor of 1.0 was used in this example

Shorted stub:

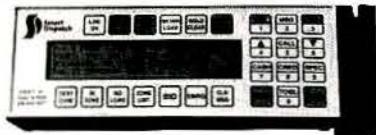
Frequency: 155MHz
Distance from stub to feedpoint: 27.35 inches or 0.359λ
Length of shorted stub: 23.75 inches or 0.312λ
Bandwidth for VSWR $\leq 1.1:1$: 150MHz-159MHz
Bandwidth for VSWR $\leq 1.2:1$: 145MHz-163MHz
Velocity factor of 1.0 was used in this example

Thus, an open transmission line stub 3.64 inches in length is placed at a distance of 21.067 inches from the load (antenna feedpoint) in order to match the 75Ω

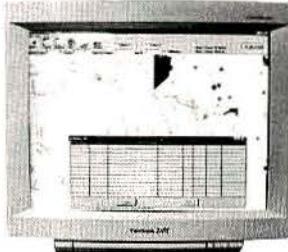
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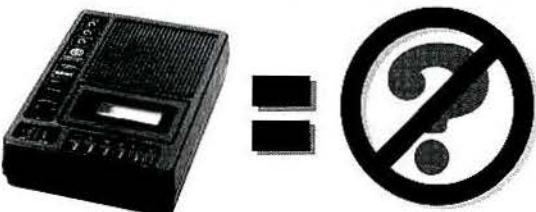
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Technically speaking

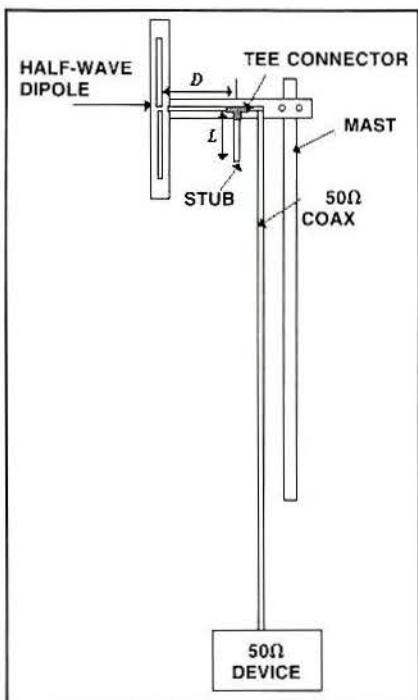


Figure 4. This shows the overall dipole antenna of Figure 1 when transmission line stub matching is employed to match the 75W antenna to a 50W system.

antenna to a 50Ω device. It is important to note that the transmission line is 50Ω , as is the stub.

Formula (1) for determining distance (D) applies to the use of shorted stubs or open stubs. However, the length of the shorted stub is determined from formula (3) in the sidebar. In these formulas the shorted stub will be $\lambda/4$ longer than the open stub. The open stub is easier to fine tune by simply snipping off small sections of the stub while observing the effect on VSWR.

For the coaxial dipole shown in Figure 2, if the distance (D) falls within the folded back section of braid, then simply add $\lambda/2$ to the distance and place the stub there. You can always add $\lambda/2$ section of cable without any adverse effects. The overall arrangement for stub-tuning the halfwave dipole of Figure 1 is shown in Figure 4 at the left.

As you can see, the transmission line stub matching scheme is practical and easy to implement once you know how long the stub should be and where it should be placed on the transmission line. Thanks to late Phillip H. Smith, inventor of the Smith chart, we can determine length and location of the tuning stub quite easily.

$$[1] \quad D = \left[\frac{(11811)(0.359)(V)}{F} \right]$$

$$[2] \quad L_O = \left[\frac{(11811)(0.062)(V)}{F} \right]$$

$$[3] \quad L_S = \left[\frac{(11811)(0.312)(V)}{F} \right]$$

where

D = distance from antenna feedpoint to stub location in inches

V = velocity factor of transmission line

LO = length of open stub in inches

LS = length of shorted stub in inches

F = operating frequency in MHz

TRANSMITTER LOCATION

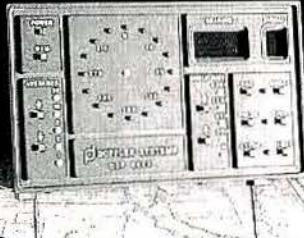


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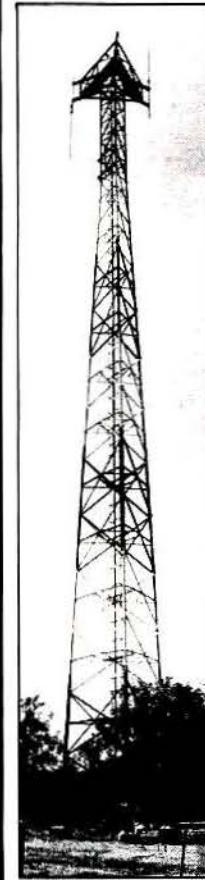
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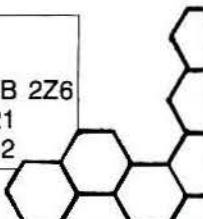
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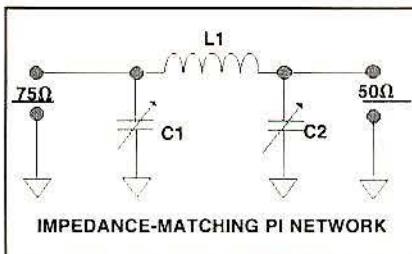


Figure 5. This pi network is an excellent impedance-matching circuit. It also provides for harmonic attenuation, because it is a low-pass filter. The filter can be fixed-tuned or variable-tuned. Commercially manufactured units are readily available, or you can design your own.

L-C Pi Network: The L-C pi network is so named because of the pi shape of the design. (See Figure 5 above.) The pi network is a valuable matching circuit. With tunable capacitors on each end the circuit can be fine tuned for excellent matching results over a broad frequency range. In Figure 3 on page 53, if C_1 is 13.54pF; L_1 , 60.37nH; and C_2 , 11.59pF, then the resulting impedance match is shown by the *return loss* graph shown in Figure 6 at the right.

The higher the return loss, the better the match and, hence, the lower the VSWR. A return loss of -30dB is equal to a VSWR of about 1.065:1. The dip in the curve at 155.3MHz corresponds to a VSWR of about 1.001:1. The pi matching network would produce an excellent match at any frequency shown on the graph.

An extra benefit of the pi matching network is the reduction of harmonics. Commercially manufactured pi matching networks are available from several of the RF equipment manufacturers under trade names such as "Line Matcher," and "Z Matcher."

RF transformer

Another method of matching impedance is through the use of an RF transformer. Such transformers are typically of the toroid type. You can wind your own or buy commercially produced transformers for higher quality and better performance. These impedance transformers are usually broadband and have fairly low insertion loss.

Conclusion

As you can see, it is fairly easy to construct simple antennas for test purposes or other special needs. With a little care in dimensions and impedance, matching such antennas can give surprisingly good results. Go ahead...experiment!

Until next time...stay tuned!

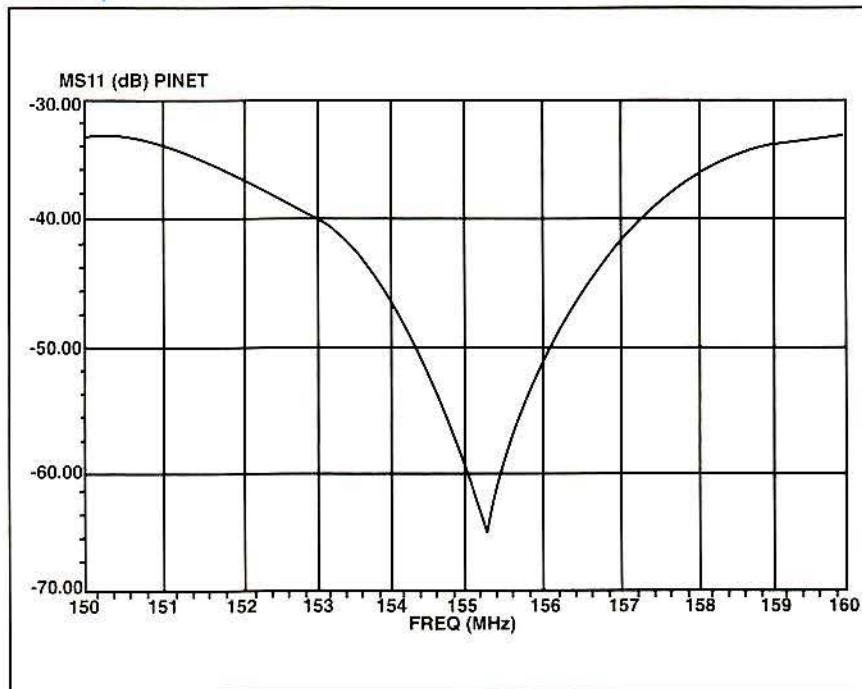
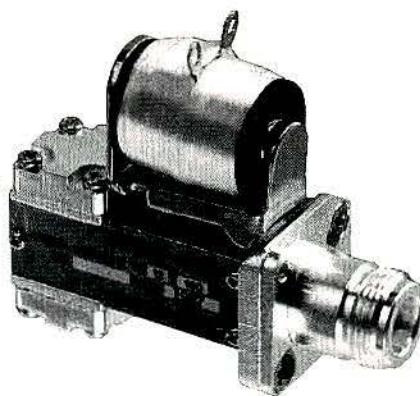


Figure 6. This graph shows how well the pi network matches the input and output impedance over the bandwidth of 150MHz-160MHz. Over this frequency range the return loss is never less than 33dB. This return loss indicates an excellent impedance match and provides for low VSWR. See text. *This graph was plotted with ARRL Radio Designer Software 1.5.*



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I'm sorry. I was wrong.

By Robert H. Schwaninger Jr.

The other day I was up at the FCC's office in Gettysburg. If you've never been there, you're missing one of the most interesting places that the FCC has to offer for a public tour. Well, they don't exactly give tours, but if you're willing to wear one of those really dorky badges that they give out (after doing a background check to see if your friends have given you a nickname like "Pipebomb" or "The Jackal"), you can kinda roam around and see people working.

That's right. Contrary to public opinion, there are people who work at the FCC. Take Terry Fishel, for example (or take him to lunch, if you don't mind being tailed by the Federal Employee Conduct Police). Terry's office is decorated in Late American Pile, and we're not talking carpeting here. His shelves have stacks of paper. His floor has stacks of applications. His chairs have stacks of petitions. Even his piles have piles that all the ointment in the world can't cure.

Schwaninger. MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.

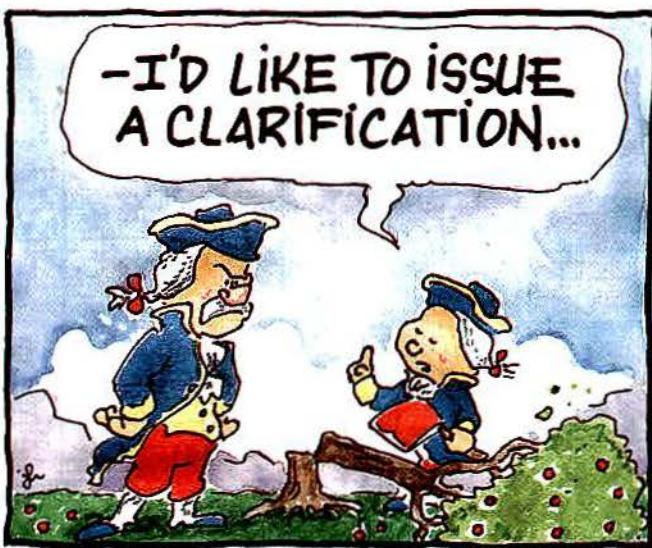
Can I get a witness! Yes, I'm here to tell you that Terry and a lot of people like him are actually trying to push it all down the "elementary" canal that we in the legal biz call due process. Add to that W Riley

capacity than the ability to actually begin and end a task. They also have the ability (and I know that I'm jeopardizing each named person's career) to say, "I'm sorry. I was wrong." Amazing!

In my most convincing Andy Rooney impression, let me ask you. "Did ya' ever notice that the Commission, with a capital 'C,' doesn't have the capacity to say, 'I'm sorry. We were wrong'?" In fact, did you notice that these words cannot be uttered by anyone with the job of Division Chief or higher? Why is that?

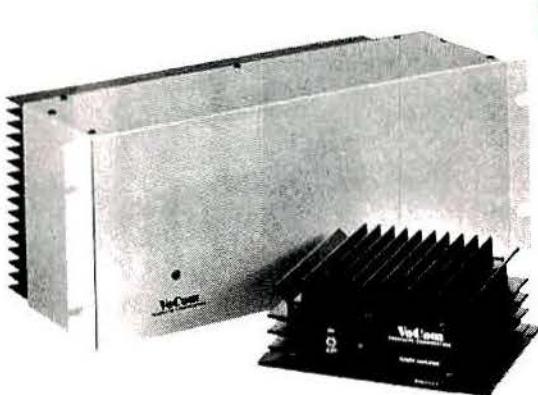
I'm starting to wonder if there's someone over at the Office of Personnel Management that's keeping score—someone named Herman Lipschitz who does nothing all day but keep track of how many times an agency has admitted that it just blew it, choked, got thrown a curve, misread the law, or really didn't intend to regulate an entire segment of the economy into the abyss. Herman counts each time, and if you go over 1.5 times, you are given the same severance package as Dick Morris.

The most recent example of this management malady was an Order produced by the Wireless Telecommunications Bureau that sought to restrict eligibility to apply for a waiver of the most recent 800MHz Report and Order to ESMR



Hollingsworth (the "W" is silent), Mike Regiec, Elaine McKnight, Joyce Nary and scores of other people who don't have the time to go to luncheons, make speeches, write white papers, adopt obscure policy, or figure out the telecommunications-industrial-fiscal-monetary-global policy for the western hemisphere and Vineland, NJ. They hardly have time to do their jobs.

But that's not the most amazing thing about these people. They have a greater



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operators only. All of the industrial, land transportation and local SMR operators could go pound sand.

As soon as the Order hit the street, some of the adversely affected companies, like Chadmoore and Spectrum Resources and others said (and I quote), "Hey! That ain't right." Well, with an overwhelming legal argument like that, their lawyers jumped in and filed a petition that pointed out to the WTB that it didn't have the authority to change the Commission's Report and Order, which had no such language in its text. The amazing thing about the objection to the petition is that there were actually three law firms (with the combined wealth roughly equivalent to the GNP of Sweden) with enough gumption to complain.

Now, the Bureau knows that it cannot issue an Order that is contrary to the specific language in a Commission Order. And, I hope, the Commission knows that the Bureau can't do that either. So, everyone knows that the Bureau messed up. I even explained it to the neighbor's terrier, and he agreed while gnawing on my rhododendron.

Now, when I mess up, I tell the person affected by my mistake. "I'm sorry. I was wrong." I also tell this to my wife when I mistakenly rent the movie "Devil Blasters from Outer Space" for romantic viewing on our anniversary. I do not issue a "Clarification."

But then I'm not Michele Farquhar with a title that begins with the word "Chief." Ms. Farquhar chose instead to issue a public notice that claimed to be clarifying the earlier Order. In her clarification, she explained that the earlier Order should not be interpreted to mean that only ESMR operators can get a waiver. Said in another way, she said that true north should be read as 180° from true north, or sort of a "non-compass mentis." What she didn't say was, "I'm sorry. I was wrong."

In trying to finesse the mess, she actually made things worse. You see, as pointed out in additional comments, her public notice cannot legally change the content of an Order. Therefore, she put a leaky bandage on a wound to the Bureau's integrity. It didn't help. It only sought to

cover up the problem.

The Order is still there. The public notice is legally insignificant. The petition filed by the lawyers is still on file, and they aren't withdrawing it yet. Now the later comments have pointed out that the public isn't fooled by this little charade.

For me, Chief Farquhar would have attained hero status if she had simply said "Whoops." I would also invite those people who dreamed up the 800MHz Consensus, auctioning channels used for BETRS so that huge paging companies could get bigger, the Goodman-Chan decision, HDTV give-aways, AM stereo rules, radiodetermination spectrum allocations, the freezes, the PCS entrepreneur block auction rules, ACSB as anything more than a novelty, farming, gangsta rap, call waiting and smelly perfume ads to join in a chorus of "I'm sorry. I was wrong."

Every month I write this column and go out on a limb. I make predictions. I

give opinions. I point out that some things just don't seem right to me. Then I let the chips fall where the cattle left them.

On occasion, some of you write to tell me that I might be mistaken. I read the mail that is promptly forwarded to my office after the magazine's staff has steamed it open and used it to mock me. When I've been wrong, I've admitted it, despite this public forum that is read by a whole lot more people than an Order written by Ms. Farquhar. In sum, I take my lumps.

I've invited people to write opposing views, debate me, or simply to call me on the phone or tell me that I'm a few sandwiches short of a picnic. It's okay. That's what being in the public eye is all about. But in Washington, that rarely happens. Instead, people whisper behind your back and oppose you by innuendo or smear.

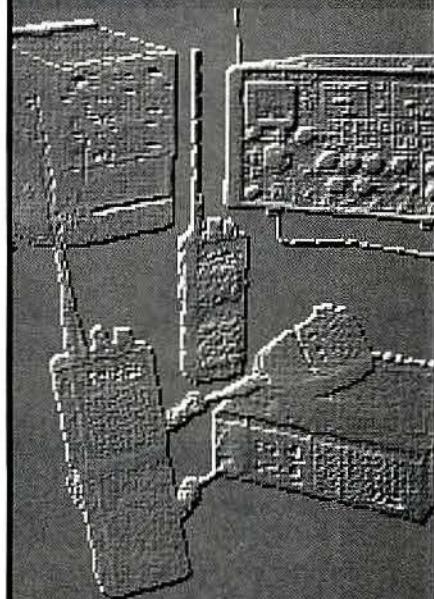
If, by the time this is published, Ms. Farquhar does the honorable thing, then perhaps I've misjudged her. If so, I'm sorry. I was wrong.



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Conxus Communications triples company's spectrum capacity

Conxus Communications, Greenville, SC, has acquired or signed options to buy about 40 specialized mobile radio (SMR) properties in the United States during the last 18 months. The acquisitions more than triple Conxus' spectrum capacity for offering mobile voice messaging and data messaging services via its narrowband PCS network, which is expected to be operational in mid 1997.

Conxus, formerly known as PCS Development (PCSD), became one of five origi-

nal 50kHz/50kHz nationwide narrowband license holders in the FCC auctions held in November 1994. Conxus president Bill deKay said that combined with the original FCC license, the SMR properties give the company the equivalent of a 175kHz/175kHz two-way nationwide network. He said that the purchases and option agreements give Conxus coverage of 37 of the top 50 markets in the United States, about 70% of the population.

Geotek, IBM enter into nationwide licensing agreement

Geotek Communications, Montvale, NJ, and IBM Availability Services have entered into a nationwide marketing agreement that will allow IBM to market Geotek's integrated suite of voice and packet data services to customers in conjunction with its own services. IBM will also provide customer support in all Geotek's U.S. markets.

The agreement is part of an ongoing relationship. Last year Geotek signed an agreement with IBM to provide turnkey site construction and project management for Geotek's digital wireless networks.

E.F. Johnson wins contract to build McLean public safety system

E.F. Johnson, Burnsville, MN, has been awarded a \$28 million contract to build a Multi-Net II trunked radio system for McLean County, geographically the largest county in Illinois.

The 800MHz three-site simulcasting system will serve seven public safety agencies in the county, including the McLean County Sheriff's Department and police and fire departments in the cities of Bloomington and Normal. The system will use more than 500 Multi-Net mobile and portable radios, as well as touchscreen consoles for a new dispatch center.

CTIA board votes on several issues

In December, CTIA's board of directors took action on four issues:

1) In a unanimous vote, the association agreed to stand fast in its commitment to the principle that the industry should establish the technical standards for meeting the legal requirements of court-ordered wiretaps. The principle was laid out by Congress in the Communications Assistance for Law Enforcement Act. In the past year the FBI has urged technical standards on the industry that go beyond the scope of this act of Congress, says the CTIA, including the capability of using wireless phones as tracking devices.

2) In October, research regarding the interaction of wireless phones on pacemakers was completed and presented to the U.S. Food and Drug Administration. The research was funded through the CTIA's research program but carried out at a variety of independent facilities. Although the research showed that the chance of interference is slight and that pacemaker manufacturers are now taking steps to insulate their products, the board voted to require that product information about such interaction must accompany all phones before they can receive CTIA certification.

3) CTIA is funding a five-year, \$25 million research program to study any bio-effects that may be associated with wireless telecommunications. The board agreed to the outline of a contract with Wireless Technology Research for reimbursing WTR's legal expenses through insurance and other means.

4) Finally, the board voted to begin work on establishing a dispute resolution mechanism for the wireless industry, possibly in the form of a mediation panel or system.

TekNow, Motorola develop open standard for two-way message entry

TekNow, Phoenix, and Motorola's Advanced Messaging Systems Division, Fort Worth, TX, have formed a strategic alliance for producing integrated products that will improve the performance of Motorola's next generation wireless messaging system. Using the new products, developers will be able to create applications that send and receive data to and from subscribers in an advanced messaging system that includes Motorola's Wireless Message Gateway (WMG). TekNow's advanced messaging data entry products for the WMG paging terminal will be developed in accordance with industry standard protocols published by the PCIA. Products will include a Telocator Message Entry (TME) Server, TME Client and Software Development Kit and an Internet gateway for E-mail-based paging.

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XyPoint drafts E9-1-1 proposal to present to state legislatures

XyPoint, Seattle, has released model state legislation designed to help wireless carriers provide enhanced 9-1-1 services to customers as mandated by the FCC. XyPoint developed the model legislation with assistance from many wireless carriers to help implement the FCC mandate requiring carriers to provide the first phase of E9-1-1 services to customers by April 1, 1998. In the first phase, carriers must provide a wireless caller's 10-digit phone number and cell-site location to emergency dispatchers.

The FCC's order, released in July, determined that both cost recovery and indemnification—two key political issues—should be resolved by state and local governments. The FCC said, however, that wireless carriers are not required to provide the improved E9-1-1 service if a local public safety community does not have the necessary cost recovery mechanisms in place to reimburse carriers for the cost of the service.

The key elements of XyPoint's model are 1) wireless carriers deserve the same broad immunity from liability for providing E9-1-1 services that wireline providers enjoy through their tariffs; 2) the primary purpose of creating cost recovery mechanisms is to implement the FCC mandate and enable public safety officials to reimburse carriers for the cost of the services; and 3) cost-recovery mechanisms must be statewide in scope rather than locally structured to ensure efficient administration.

Motorola offers iDEN technology in 900MHz frequency band

Motorola's Land Mobile Products Sector, Schaumburg, IL, will offer its iDEN technology in the 900MHz band. The new offering allows commercial radio service operators to maximize the dispatch capacity of their 900MHz channels and provides the flexibility to add optional services such as full-duplex telephone interconnect, alphanumeric paging and data and fax communication services.

iDEN technology is available in the 800MHz and 1.5GHz bands and uses a variety of advanced technologies, including vocoders, M16QAM modulation and TDMA.

In the 900MHz band, iDEN will combine pairs of 12.5kHz channels to create a 25kHz channel. Using TDMA, the paired channels will be split into six time slots, tripling the RF capacity of each 900MHz channel. The technology is targeted to be available late in the fourth quarter in 1997.

Metawave receives antenna patent

Metawave Communications, Redmond, WA, has been awarded a patent by the U.S. Patent Office for a narrowbeam antenna system with angular diversity. The multi-beam antenna system improves the performance of CDMA systems, using increased antenna gain and narrow angle antenna beams to reduce interference. The system also eliminates the need for space diversity antennas.

PanaVise moves to new office

PanaVise Products, Reno, NV, has moved to a custom 58,000 square-foot factory, a move that capped the company's 40th anniversary year. The company manufactures communications mounts and accessories. The new address is 7540 Colbert Drive, Reno, NV 89511. Tel. 702-850-2900; Fax 702-850-2929.



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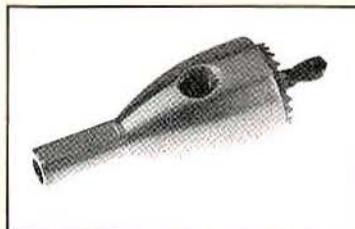
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Readers' choice

Of all the new products and services in the June 1996 issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

Saw cuts hole in vehicles for $\frac{3}{4}$ " hole mounts



The HS34 hole saw cuts a hole in a vehicle's surface to allow the installation of industry-standard $\frac{3}{4}$ " hole mounts. The saw from **Antenex** is made from a single

piece of hardened tool steel, so it will not break apart on the job. A self-centering pilot drill prevents the saw from "walking." A $\frac{1}{8}$ " depth limit prevents damage to the underlying headliner, yet is deep enough to cut through thicker aluminum surfaces on utility vehicles and some ambulances. The saw is designed for a $\frac{3}{8}$ " chuck and is nickel-plated to prevent rusting.

Circle (500) on Fast Fact Card

Wireless PBX interfaces trunked, conventional SMR

The Mobile Communication Switch from **Radio-Onde** is a wireless PBX for interfacing any trunked or conventional mobile radio system. The MVM 10-100 allows an SMR operator to offer value-added service to customers such as telephone, voice messaging, call transfer and paging. Features include call forward, call transfer, follow-me roaming, one-number services and call networking.

Circle (401) on Fast Fact Card

Flexible $\frac{1}{4}$ " cable matches corrugated cable loss rates



The LMR-300 $\frac{1}{4}$ " low-loss flexible cable from **Times Microwave Systems** is designed to provide loss equivalent to a $\frac{1}{4}$ " superflexible corrugated copper cable. Components include a solid copper center conductor, a low-loss polyethylene foam dielectric, a bonded aluminum-tape outer conductor with an overbraid and a black, weather-resistant, polyethylene jacket.

Loss is rated at 6.1dB/100 feet at 900MHz with shielding better than 90dB. The cable can be used for system interconnects and short antenna feeders. A low-smoke, fire-resistant-jacket model is available for UL riser requirements.

Circle (402) on Fast Fact Card

Spectrum analyzers cover 9kHz to 8.1GHz range

Anritsu Wiltron

has expanded its portable spectrum analyzer platform with the models MS2653A and MS2663A. The analyzers cover the 9kHz to 8.1GHz range. Dynamic range of the MS2653A is 105dB, 110dB for the MS2663A. Average noise level is ≤ -110 dBm for the MS2653A and ≤ -115 dBm for the MS2663A. The MS2653A is designed as a maintenance analyzer, while the MS2663A is suited for manufacturing and installation applications. High-speed time-domain sweep times are 12 μ s. Both units are equipped with a built-in controller function and offer a PCMCIA-compatible memory card interface. Application-specific software programs can be saved to the memory card from a PC and downloaded to the analyzer for fully automated measurements.



Circle (403) on Fast Fact Card

Alphanumeric pager offers 64,000-character memory



The Precis alphanumeric pager from **Panasonic** features a four-line, 80-character display and a 64,000-character memory. The extended memory allows paging service providers to offer customers messaging services such as E-mail. Based on the Flex

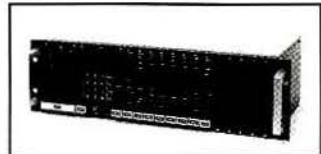
protocol, the 900MHz crystal pager offers 50 message slots, 16 addresses (capcodes), memory backup, time-and-date display, message time-and-date stamp, alarm clock, headline scroll and a contrast-adjustable LCD. Extended battery life, as long as four months, is available.

Circle (404) on Fast Fact Card

Interface system allows band-to-band communication

The CBI-5 Crossband Interface System allows as many as five UHF/VHF radios to intercommunicate freely from band to band under portable or mobile radio operator control.

Crossband operation takes place in various configurations, including any two bands at a time or all bands simultaneously. The unit from **JPS Communications** can be controlled via DTMF commands from the radios, its front-panel keypad or by a connected PC. A telephone interface allows outside callers to dial into the system using passwords and to pass telephone communications over the radio bands interfaced through the unit. Conversely, a portable or mobile radio user can use access codes to initiate a telephone call through the CBI-5. The module also contains a handset connector and speaker and provides voice prompts to guide users through all phases of operation.



Circle (405) on Fast Fact Card

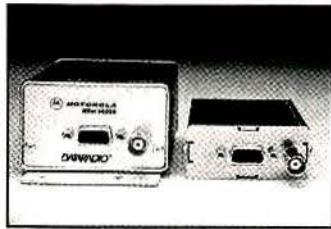
Campus paging system can handle 9,999 pagers



Telepath 450 from **Interpage** sends numeric, tone or silent vibration messages to individuals or employee groups within a one-mile radius using a standard telephone or the keypad on the unit. The system is equipped with two dry contacts, expandable to 256, to monitor security, production control or building automation systems. Serially programmable, the system will accept as many as 50 preprogrammed numeric messages sent from any telephone or alarm panel in the system. Messages are transmitted from the console to the pagers within two seconds. The Telepath 450 can accommodate as many as 9,999 pagers. The console is about the same size as a standard business telephone.

Circle (406) on Fast Fact Card

Modem provides telemetry, control for 450MHz



The RNet 9600S radio modem is designed for 9,600bps telemetry, control and fixed data applications operating at frequencies in the 450MHz-470MHz range. As many as eight channels can be programmed, and diagnostics can be performed OTA without network shutdown. Diagnostic data can be downloaded to external systems or to storage media for later analysis. The modem uses Microsoft Windows-based software for point-and-click setup, cloning and verification. The modem is a cooperative venture between **Dataradio** and the Derivative Technologies division of **Motorola**'s Messaging Systems Group. Dataradio designed the synthesizer loader board and the programming software. Motorola designed the radio and manufactures the products.

Circle (407) on Fast Fact Card

Auxiliary generators offer 8 hours of backup power



The Auxiliary Power System series of emergency standby generators from **Generac** include voltage monitoring, automatic start and stop, safety shutdowns and system battery charging. The generators can maintain backup power for as long as eight hours. Options include ac or dc outputs, telemetry monitoring, automatic transfer switch and weatherproof outdoor enclosures. The overhead valve engines feature forced-air cooling through the engine and alternator. Rated from 3kW to 8kW, the engines can be fueled by LP or natural gas.

Circle (408) on Fast Fact Card

DSPatch

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Utilities, airlines, railroads, public-safety, military and other government agencies worldwide have come to rely on Avtec for advanced, high-capacity console solutions for integrated radio/telephone systems. DSPatch is a color touch-screen console system that employs Digital Signal Processors (DSP's) at every line and workstation. Its distributed architecture ensures instant responses, even in large systems. DSPatch may be configured to support from 32 to 1,024 external lines or operator workstations.

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DSPatch32, a 32-port system, is available for smaller applications.

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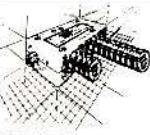


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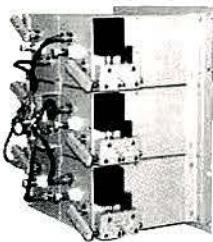
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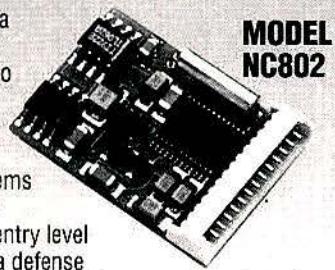
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Circle (43) on Fast Fact Card

VOICE SECURITY ENCRYPTION



The Model NC802 is a miniature inversion scrambler designed to provide intermediate level security for two-way radio voice communication systems and is a perfect, cost effective solution to entry level voice scrambling as a defense against unauthorized or casual listeners. The NC802 provides eight user selectable carrier codes commonly used by other manufacturers and interfaces easily to most radios with near transparency to the user.

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Circle (44) on Fast Fact Card

New products

AVL-dispatch system supports fleet management

The Trakit AVL system for vehicle fleets combines business radio and Global Positioning System (GPS) technologies. The application from the MD/GPS division of IDA tracks and displays vehicle locations on a Microsoft Windows 95-based computer at the dispatch center in real time on supplied screen maps. Vehicle activity can be replayed for efficiency analysis or exported to cost or billing applications. The system is designed for 220MHz, 450MHz, 800MHz, shared or dedicated, trunked or conventional radio systems. The GPS receiver and location transmitter box can be placed anywhere in the fleet vehicle.



Circle (409) on Fast Fact Card

Mobile software modules speed police field work



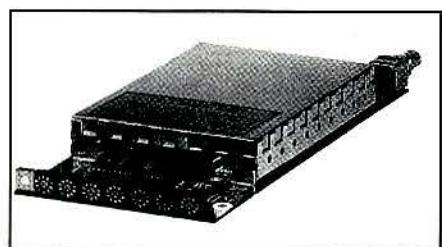
PoliceWorks is the most recent addition to the RadioWare Software Solutions Portfolio from **Motorola Land Mobile Products Sector**. The set of modules is designed to simplify time-consuming, redundant reporting tasks for in-service mobile law enforcement officers. Electronic queries are accessed via radio data

networks and can be shared with other modules in the set. Person or vehicle data can be entered once and forwarded to other modules, flowing from one report to another. The seven modules are MDT (including links to local, state and national public safety databases), accident, citation, incident, field interview, arrest/booking and tow slip. The modules operate with Microsoft Windows and run on keyboard, pen-based or touchscreen computers. PoliceWorks also works on Motorola's Forté wireless communications pad (shown).

Circle (410) on Fast Fact Card

VHF synthesized receiver supports digital data

The DCL-VHF-DX is a synthesized, digital receiver operating in the 153MHz-173MHz VHF band. The receiver from the Neulink division of **RF Industries**



supports digital data and is designed to yield high-performance audio output. The bandspread is 10MHz, and the receiver can be tuned to any frequency in the selected band. The receiver measures 3 1/2" x 7 1/2" x 1". The antenna port is a female BNC connection.

Circle (411) on Fast Fact Card

Headsets counter noisy two-way environments



The Otto V4000 headsets from **Otto Communications** feature noise-attenuating ear seals, flexible booms with a noise-canceling electret microphone, in-line PTT and durable cables. The headsets feature a 24dB noise-reduction rating (NRR) for applications in environments such as construction sites or industrial plants. Speaker elements are designed to withstand mechanical and thermal shock. Two headset styles are offered: an over-the-head model and a behind-the-head model for use with protective headgear. The standard in-line PTT switch offers another degree of control to a belt-mounted radio. The PTT can be worn down one sleeve for palm operation or clipped to clothing for easy access.

Circle (412) on Fast Fact Card

Remote control interfaces with antenna rotators

Sabre Communications' RC-10 micro-computer-controlled antenna positioning system is designed to interface with the APA-3, APA-4, APA-5 and APA-6 rotators. The system also can be retrofitted to control other makes of rotors. The RC-10 provides digital readouts and controls antenna positions as far away as 2,000 feet from the antenna site. Components include the tower unit, the rotor electronics package and the site control unit located in the radio operations center.

Circle (413) on Fast Fact Card

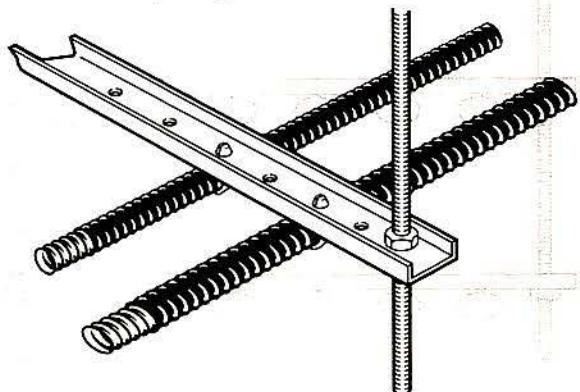
In-field spectrum analyzer features weatherproofing



encased in rubber and has a rain-resistant front panel, shielded vents and a side-mounted fan for adverse weather. The unit requires only five minutes to warm-up and has automatic RF input overload protection. Features include one-button measurements for bandwidth, third-order intercept and amplitude modulation. Range for the unit is 9kHz to 1.5GHz with a frequency accuracy of $\pm 2.0\text{kHz}$.

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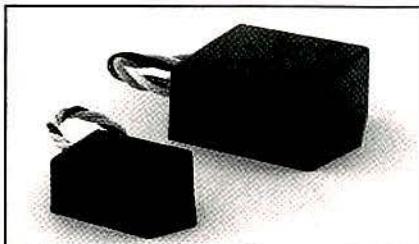
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Circle (46) on Fast Fact Card

New products

Low-pass filter protects vehicle radios from transient ignition spikes



The NS3035 Noise Suppressor from **Antenex** is a 30A-rated, general purpose, low-pass filter used to reduce power line noise. The unit protects sensitive communication devices from large transient spikes generated by a vehicle's ignition system. The high-impact housing is waterproof and vibration-proof.

Circle (415) on Fast Fact Card

Digital controller for wall-mount air conditioners monitors remotely



The Telcom Climatewatch TCS20 from **Bard Manufacturing** is a building monitor and direct digital control for two Bard wall-mount air conditioners for a redundant system. Remote monitoring of a site's AC units is based on user-defined control strategies. System software is compatible with Microsoft Windows 3.1 and Windows 95 applications. Features include built-in indoor or outdoor temperature sensors, an outdoor humidity sensor and an adjustable 24- to 168-hour changeover timer. The monitor operates on a 208V/240V 50Hz/60Hz power supply.

Circle (416) on Fast Fact Card

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Circle (48) on Fast Fact Card

RF power monitor continuously covers SMR, PCS, AMPS channels



Zetron's model 5150 MultiChannel Power Monitor continuously monitors as many as 64 individual RF channels for SMR, AMPS or narrowband PCS. When RF power level drops, antenna VSWR increases or channel inactivity is too long, an alphanumeric page can be automatically sent through the unit's RS-232 port to show which channel needs maintenance and what condition triggered the alarm. The unit installs at the output of a combiner or linear power amplifier. A 10.7MHz out-connector on the front panel allows connection of external test equipment for troubleshooting of individual channels.

Circle (417) on Fast Fact Card



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New products

Surge arrestors use dc passing circuit to protect antennas



The SA surge arrestors from Andrew combine gas tube and solid-state transient suppression technology for multistrike protection for 1,850MHz-1,990MHz PCS, 1,550MHz-1,600MHz GPS, and 800MHz-960MHz cellular and LMR antennas. Each arrestor has a dc passing circuit to allow current to pass via the center conductor to provide power to the antenna's preamplifiers. The arrestors are equipped with Type N connectors at the input-output interface.

Circle (418) on Fast Fact Card

Site monitor and controller combines multiple functions in one unit

King Communications' Senitor combines RF monitoring, a hot-standby controller, site management and tower light control in one package. The unit can be addressed by either RF or telephone modems from a central location without the need for an on-site computer. Each site

can be fully programmed via a PC. Event logs are maintained both at the site and the central control location. Activities the unit can control include RX sensitivity, TX power, VSWR, ac, alarms, entry systems and site lighting.

Circle (419) on Fast Fact Card

Distribution

Motorola Paging Products Group, Derivative Technologies Division, Boynton Beach, FL, selects Solo America, Greenville, SC, as a distributor for its RSVP pager. In addition to accepting orders for RSVP units, Solo America will arrange for paging service anywhere in the United States.

For more information, call 888-541-7656

Dallas-based national distributor Hutton Communications has relocated its Atlanta and Denver sales offices and warehouses into larger facilities. The Atlanta facilities serve the Southeast, and the Denver facilities serve the Rocky Mountain states. The two sites are co-located with the facilities of Andrew Corporation. The Atlanta-area site is now at 1775 MacLeod Drive, Lawrenceville, GA 30243. The Denver site is now at 5500 Havana St., Denver, CO 80239.

For more information, call 972-239-0580

VCP International, Dallas, is providing the Stratus alphanumeric pager from Panasonic to resellers.

For more information, call 800-442-7001

Kikusui Electronics, Japan, selects Marconi Instruments, Fort Worth, TX, as the exclusive U.S. and Mexico distributor and servicer for its PAN series of dc power supplies.

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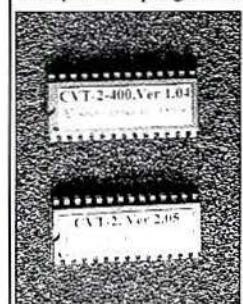
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Circle (63) on Fast Fact Card

EEPROMs Provide Trunking Conversion for Mobiles

IDA Corporation of Fargo, ND announces the availability of LTR trunking conversion EEPROMs for various Motorola and Motorola Radius mobile radios. The replacement EEPROMs are available for popular models in the 400 MHz, 800MHz and 900MHz bands. LTR conversion of Privacy Plus mobile phones is also being offered. An inexpensive programming kit is required



to program the converted mobiles. Post-conversion features include group scan, TX time-out timer, trunked or conventional operation, CTCSS and

CDCSS, block decode and automatic channel acquisition.

IDA CORPORATION

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Circle (66) on Fast Fact Card

Catalog offers quick change, high-power RF coaxial connectors

The eight-page QC Series high-power RF coaxial connectors catalog from **Tru-Connector** offers a full line of quick change RF connectors for wattmeters and high-power testers, providing a way to match equipment and maintain high-integrity connections. The catalog is com-

plete with detailed drawings, dimensions and part numbers, and describes a series of quick-change connectors featuring a common base plate that accepts a wide variety of connector styles to permit fast on-site changes, simply by removing four screws.

Circle (250) on Fast Fact Card

Product catalog includes 6,000 new items, software, supply section

Catalog number 38 from **MCM Electronics** features more than 6,000 new items including project accessories, semiconductors, connectors, test equipment and computer products. New sections are

Computer Software, Data Comm, Office Supplies, Printer Parts and Safety. Franchised lines are introduced in this catalog for the first time from Lexmark, ECG/Philips and Sencore.

Circle (251) on Fast Fact Card

Catalog release coincides with company name change

CES Wireless Technologies (formerly Communications Electronics Specialties) has released its 24-page product catalog for 1997. Included in the catalog are such recently released product series as mobile

data, truck tracking, GPS, status and computer dispatch software systems that complement the company's existing range of telephone interconnect, trunking controller and fleet management products.

Circle (252) on Fast Fact Card

Bulletin covers measurement and performance standards

The bulletin, "Land Mobile Linear Analog Modulation Communications Equipment Measurement and Performance Standards," from the **Telecommunications Industry Association (TIA)**, seeks to standardize parameter titles, definitions, test conditions and methods of measurement used to evaluate the performance of equipment. It also seeks to create a comparison of the results of measurements made by different observers and on different equipment and to provide separate standards for base stations, mobiles and portable/personal equipment.

Circle (253) on Fast Fact Card

Controls catalog offers a product selection fast-find guide

The 32-page controls catalog from **SSAC** features in-stock controls including time-delay relays, encapsulated timing modules, universal timers and alternating relays, to name a few. A complete index and "fast find" guide ease product selection.

Circle (254) on Fast Fact Card



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Changes at Advanced Radio Telecom, Bellevue, WA:

Richard A. Shields, vice president of technology development, advances to senior vice president of technical operations.

Timothy C. Marshall leaves AT&T Wireless Services, Seattle, as director of the engineering program office to join Advanced Radio Telecom as director of program management.

Alan Z. Senter leaves Nynex, New York, as executive vice president to join Advanced Radio Telecom as a member of the board of directors.

Eric Schimmel, vice president of the Telecommunications Industry Association (TIA), has been elected president of the Institute of Electrical and Electronic Engineers (IEEE) Vehicular Technology Society for 1997 by the society's board of governors.

Changes at Uniden America Corporation (UAC), Fort Worth, TX:

Paul Davis, former executive vice president of sales for UAC, becomes executive vice president of Uniden USA Incorporated (UUI), an OEM sales organization.

Al Siverberg, vice president of consumer sales, moves up to executive vice president of sales.

Eiji Hayasaki, director of consumer sales, advances to vice president of consumer sales.

Harris Bookfor departs Paging Partners, Freehold, NJ, as vice president of sales and marketing to join UAC as vice president of pager sales.

Steven L. Buckley, senior manager at The Warner Group, Woodland Hills, CA, is promoted to consulting partner.

Changes at PageMart Wireless, Dallas:

Richard E. Weitzel departs HCI, Dallas, as vice president of marketing and corporate communications to become vice president of marketing at PageMart. Weitzel succeeds **Richard Nelson**, who has been promoted to president of the company's subsidiary, PageMart International.

Charlie R. (Chuck) Martin leaves Trammell Crow, Tampa, FL, as regional construction manager to join Lawrence Behr Associates, Greenville, NC, as manager of RF shielding.

The Electronic Industries Foundation (EIF), the philanthropic sector of the Electronic Industries Association (EIA), announces the establishment of the Bill Boss Hall of Fame named for long-time supporter, **William E. (Bill) Boss**. The award was unveiled at the Foundation's 20th anniversary celebration and honors Boss for his "service to the Foundation, the Association and the electronics industry."

Changes at Allen Telecom Group's Decibel Products Division, Dallas:

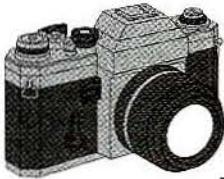
James Ryals leaves Ericsson Radio Systems, Richardson, TX, as technical trainer to join Decibel as product line manager.

Dale Ryals leaves Electrospace Systems, Richardson, TX, as program manager to join Decibel as product line specialist for cable products.

Kathryn Surace-Smith leaves Alcatel Telecom, Paris, as international counsel to join Metawave Communications, Redmond, WA, as general counsel.



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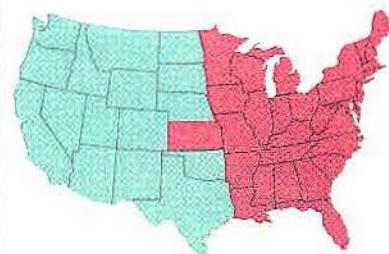
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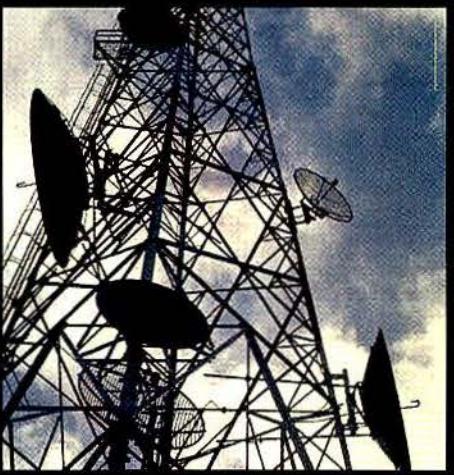
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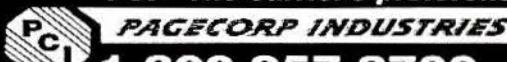
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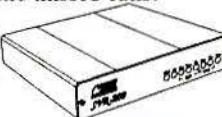
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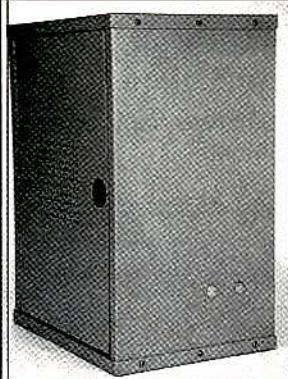
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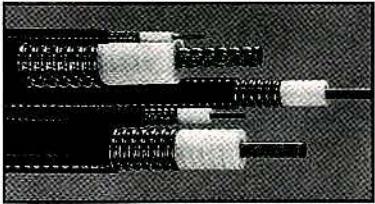
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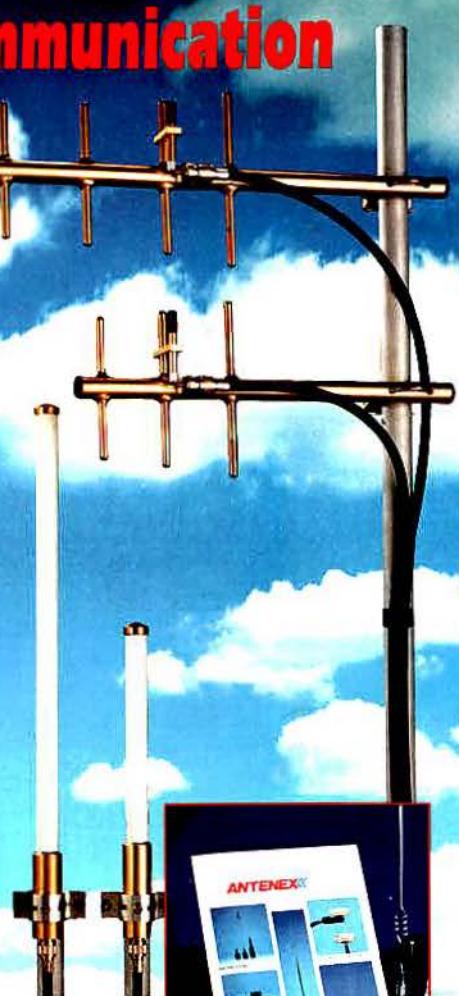
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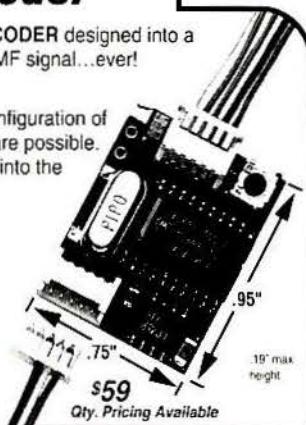
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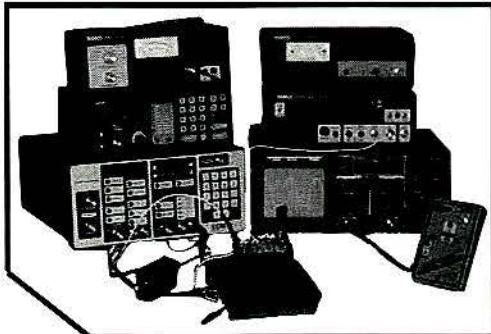
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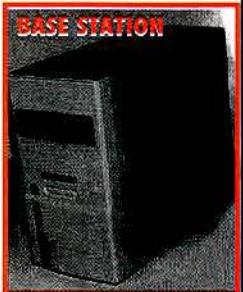
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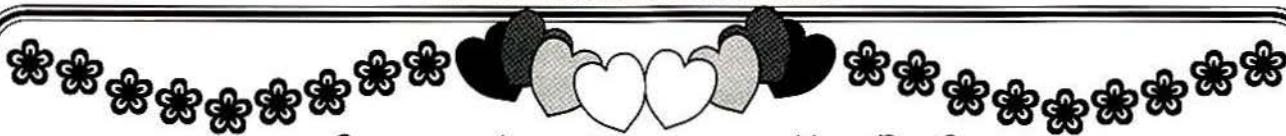
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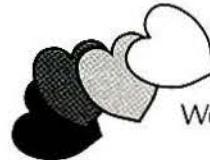
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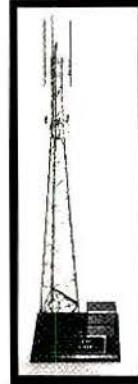
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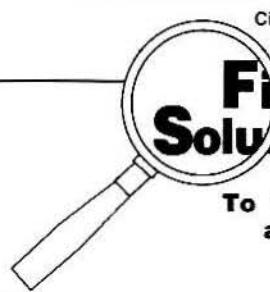
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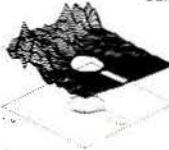
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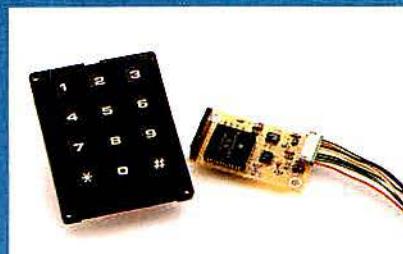
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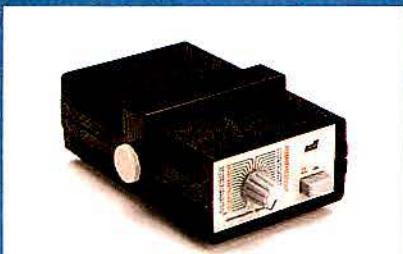
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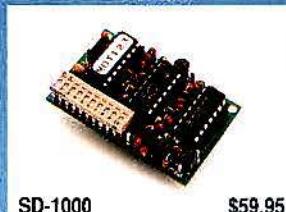
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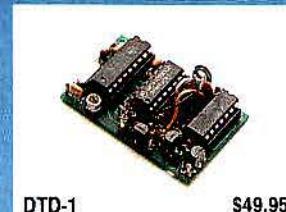
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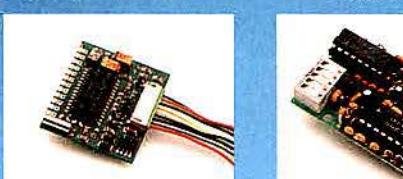
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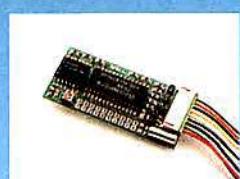
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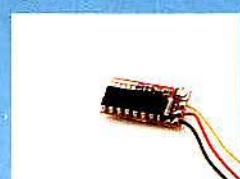
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